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# The nutrient compositions of National Heart Foundation approved beef

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# THE NUTRIENT COMPOSITIONS OF NATIONAL HEART FOUNDATION APPROVED BEEF

A thesis submitted by

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## ABSTRACT

In recent years, concern over the relationship between dietary fat intake and disease in Australia, has been associated with consumers and health professionals questioning the nutritional value of red meat, and demanding leaner meats. Although fourteen National Heart Foundation (NHF) approved beef cuts were launched in 1987, the lack of accompanying nutrient composition data has limited their promotion as a healthy food choice.

This study aimed to provide Australians with accurate information about the nutrient compositions of these fourteen National Heart Foundation approved beef cuts, in their raw and cooked forms. The rationale for the study was that the data included in the *Composition of Foods, Australia* (Cashel, K. et al., 1989) were not representative of the nutrient compositions of these beef cuts, and that the publication of this information was long overdue.

The study involved the purchase of 150 NHF approved beef samples by ten 'mystery' shoppers. A representative sample of these beef cuts was purchased from retail outlets across the Sydney metropolitan area.

The beef samples were transported to the Australian Government Analytical Laboratories in Seaton, South Australia on the day of purchase. There, the nutrient

compositions of the raw and cooked beef mince and the gross compositions of the thirteen raw beef cuts were determined. The nutrient compositions of the thirteen raw and cooked beef cuts (excluding beef mince) were determined at the National Food Authority, by computations from previous Australian beef composition studies.

A comparison of the mean fat content of the NHF approved beef cuts (raw and cooked), with those untrimmed, comparable beef cuts published in 1989 (Cashel, K. et al., 1989), revealed that the NHF approved beef cuts were significantly leaner ($p<0.01$). The NHF approved beef cuts (raw and cooked) also were found to be significantly leaner ($p<0.01$) than similar, trimmed U.S.A. beef cuts (Anderson, B.A. et al., 1990). These findings indicate that the NHF approved beef cuts (raw and cooked) are the leanest range of beef cuts available in Australia and the U.S.A.

Knowledge about the compositions of these NHF approved beef cuts should help to dispel the fears Australians have about red meat. The NHF approved beef cuts are a healthy red meat choice. The regular provision of accurate Australian food composition data is a necessity if the role of food items in the Australian diet are to be appropriately portrayed.

# CHAPTER ONE

# INTRODUCTION

## 1.0 INTRODUCTION

In recent years, recommendations by health professionals have increased consumers' awareness about the potential effects of their diet on future health. As a result, Australian consumers have become concerned about their diets, and particularly their level of fat intake (Hosking, M. and Rogers, J., 1989).

These health concerns were associated with Australians questioning the nutritional value of red meat in their diet, as it was thought to be related to, "a high fat intake", and was therefore, "a health risk" (Thornton, R.F. et al., 1987, p.30). The apparent consumption of red meat has declined since 1977, and Australians have demanded leaner red meats (Fantini, L., 1990).

The Australian Meat and Livestock Corporation (AMLC) has responded to these demands by undertaking a number of intensive production and marketing campaigns. One of these campaigns resulted in the availability of a range of lean beef cuts. In 1987, the Australian Meat and Livestock Corporation launched a national campaign to meat retailers, to encourage them to provide consumers with a range of beef cuts, which were trimmed of all visible selvedge fat (AMLC, Personal Communication, 1993).

Today, there are fourteen lean beef cuts, identified in Table 1.1, which are referred to as National Heart Foundation approved beef cuts. The fat, cholesterol and sodium contents of these beef cuts were determined at the Australian Government Analytical Laboratories (N.S.W.) in 1987 (AMLC, Personal Communication, 1993). Nutrient composition data, published in 1989, also identified that the lean portions of these cuts from regular beef had a fat content of less than ten percent, and a sodium content of less than 120mg per 100 grams. This was consistent with the National Heart Foundation's food approval criteria (National Heart Foundation of Australia, 1992). Therefore, although comprehensive nutrient compositions of these cuts have not yet been determined, or made available to the Australian public, these beef cuts have been given the tick of approval, which enables consumers to easily recognise lean beef.

**Table 1.1: The Fourteen NHF Approved Lean Beef Cuts**

| | |
|---|---|
| Eye fillet steak | Topside steak |
| Eye fillet roast | Cornercut topside roast |
| Skirt steak | Topside strips |
| Round steak | Topside cubes |
| Rump steak | Mince |
| Boneless blade steak | Silverside roast |
| Boneless sirloin steak | Silverside minute steak |
| | (AMLC, 1992) |

A 1993 national survey revealed that thirty percent of Australian retailers are offering these lean beef cuts (AMLC, 1993a). Although these beef cuts are available nationally, comprehensive nutrient composition studies have not yet been conducted. Further, the data in *the Composition of Foods, Australia* (Cashel, K. et al., 1989) are not entirely representative of these lean beef cuts.

Recent market research has indicated that consumers want more detailed nutritional information about red meat and its value in the diet (Dangar Research, 1992). A combination of inadequate nutritional data and consumer demands meant that a study was necessary to determine the nutrient compositions of these lean beef cuts. The Australian Meat and Livestock Corporation are the relevant industry group to conduct such a study and in January 1993 they initiated the current study.

The rationale for the study is that it will provide Australians with accurate and up to date information on the nutrient compositions of the fourteen National Heart Foundation approved beef cuts, in their raw and cooked states. These data will be published for each beef cut, in the *Australian Food Composition Tables*, in their 'as purchased' form, to allow health professionals and consumers to be accurately informed about the nutrient content of lean Australian beef.

As beef composition studies have been conducted previously and will be conducted in the future, the consistency of the methods was considered very important.

A number of people with expertise in particular areas were commissioned by the Australian Meat and Livestock Corporation to participate in this study. Representatives from the Australian Bureau of Statistics, the Australian Government Analytical Laboratories and the National Food Authority contributed to the study so that the data gained would be comparable with other food composition data used in Australia in 1993.

Throughout this study the role of the author was that of the primary research assistant. This involved the co-ordination of numerous people, places and events, so that the study could be completed. Although the primary research assistant was not commissioned to complete several of the components of this study, a detailed understanding was developed of the components involved in a successful food composition study. Therefore this report will provide the primary research assistant's interpretation of the study, as gained by co-ordinating the study and liaising with the team of professionals assigned to conduct the statistical sampling, chemical analyses and nutrient computation components of the study.

## 1.1 THE AIM OF THE STUDY

The aim of this study is to determine the nutrient compositions of the fourteen National Heart Foundation approved beef cuts, in their raw and cooked forms.

## 1.2 THE OBJECTIVES OF THE STUDY

The objectives required to achieve this Aim include:

(1) To obtain the gross compositions of thirteen raw National Heart Foundation approved beef cuts (excluding lean beef mince).

(2) To determine the nutrient compositions of the thirteen raw National Heart Foundation approved beef cuts, by computations from previous beef studies.

(3) To obtain the gross compositions of thirteen cooked National Heart Foundation approved beef cuts, by computations from previous beef studies.

(4) To determine the nutrient compositions of the thirteen cooked National Heart Foundation approved beef cuts, by computations from previous beef studies.

(5) To determine by analysis the nutrient compositions of the raw and cooked National Heart Foundation approved beef mince.

## 1.3 THE DEFINITIONS FOR TERMS USED IN THIS REPORT

- **Apparent consumption** - This refers to the amount of a food that is available for consumption at a particular time. These figures are influenced by trade, production and the economy. Further, it must be highlighted that when considering meat, the apparent consumption figure includes the lean meat, the fat and the bone. Therefore it overestimates the mass of meat available for consumption, especially when the meat is trimmed (Fantini, L. and MacDonald, N.A., 1987).

- **Composite sample** - A composite sample is prepared by homogenising equal amounts of several samples, which were purchased from different locations. This sample aims to be representative of the samples collected for a particular food, yet is less resource intensive than replicate sampling (Greenfield, H. and Southgate, D.A.T., 1992).

- **Cryovac packaging** - The mechanical wrapping and sealing of food in an air tight medium, so as to protect it from air oxidation and spoilage (AMLC, Personal Communication, 1992).

- **Gross composition** - The gross composition indicates the relative proportions of the lean meat, fat, bones and gristle in a cut of meat (Greenfield, H. et al., 1987).

- **<u>Homogenise</u>** - Food samples need to be homogenised, or mixed into a uniform mass, by a food processor, so that accurate and reproducible data can be gained (Cunningham, J.H., 1990).

- **<u>Nutrient composition</u>** - The nutrient composition indicates the amounts of analysed nutrients in a particular food. In Australia, nutrient compositions are usually stated per 100 grams edible portion (English, R. and Lewis, J., 1991).

- **<u>Replicate sample</u>** - Replicate sampling involves the individual analysis of all the samples collected for a particular food. It allows identification of the variation between samples from different areas. However, it is an expensive approach and thus composite sampling is more frequently used (Greenfield, H. and Southgate, D.A.T., 1992).

# CHAPTER TWO

# LITERATURE REVIEW

## 2.0 INTRODUCTION

Historically, beef was a staple food in the Australian diet (Thornton, R.F. et al., 1987). However, in recent years, its apparent consumption has decreased by forty-three percent (Hosking, M. and Rogers, J., 1989).

The increased nutritional awareness of consumers, and the impact of the media and some health professionals have caused people to question the nutritional value of Australian beef (Thornton, R.F. et al., 1987). Clearly, other factors are involved in the reduction of beef in the Australian diet. However, it is evident that there is a real and growing demand for lean meat by Australian consumers (Fantini, L., 1990).

The 1987 introduction of the range of National Heart Foundation approved beef cuts, which were trimmed of all visible selvedge fat, was a response of these demands. Although the fat, cholesterol and sodium contents of these beef cuts were determined in 1987 (AMLC, Personal Communication, 1993), none of these lean beef cuts have yet been analysed comprehensively, and none of the currently available food composition data are reflective of their 'as purchased' nutrient composition.

Thus, although the availability of these lean beef cuts can be advertised, detailed information regarding their contribution to the Australian diet can not be provided. Therefore, this literature review will discuss:

1. The influences on the consumption of beef by Australians;
2. A history of the nutrient composition of Australian meats;
3. Previous composition studies on Australian and overseas beef;
4. The production, and marketing of Australian and overseas beef; and
5. The applications of nutrient composition data.

The literature review will argue the need for the current study, which will determine the nutrient compositions of the fourteen National Heart Foundation approved beef cuts - a range of lean beef which was introduced in response to consumer demands.

## 2.1 THE INFLUENCES ON, AND CONSUMPTION OF AUSTRALIAN BEEF IN RECENT YEARS

Traditionally, an ample supply of meat, and its low price, meant that red meat was a popular food item in Australian households (Clements, F.W., 1986). However, the last two decades have seen an increased consumer interest in health and nutrition (Hosking, M. and Rogers, J., 1989). The relationships between diet, nutrition and health have received much attention and have influenced the consumption of animal products in countries like Australia, where diet related diseases are common (Thornton, R.F. et al., 1987).

In 1979, the Commonwealth Department of Health (now the Commonwealth Department of Health, Housing, Local Government and Community Services) initiated a food and nutrition policy in an attempt to improve the health of all Australians. Accompanying this policy were eight dietary guidelines for good health, which are listed in Table 2.1.

**Table 2.1: The Australian Dietary Guidelines (1979)**

" 1. Promote breast feeding.
2. Choose a nutritious diet from a variety of foods.
3. Control your weight.
4. Avoid eating too much fat.
5. Avoid eating too much sugar.
6. Eat more breads and cereals (preferably wholegrain) and vegetables and fruits.
7. Limit alcohol consumption.
8. Use less salt"
(Commonwealth Department of Community Services and Health, 1988, p4.)

At this time, diet related disease constituted sixty percent of deaths in the Australian population. All of the dietary guidelines were considered important. However, the guideline referring to fat was the focus of much attention for the media and health professionals, due to its association with coronary artery disease, hypertension and stroke (Commonwealth Department of Community Services and Health, 1988).

The dietary guideline, "Avoid eating too much fat", encouraged Australians to consider the fat and cholesterol content of their diets (Commonwealth Department of Community Services and Health, 1988, p.13). However, a lack of up to date data on Australian meat composition meant that media campaigns and health professionals often recommended that people reduce their intake of animal products, including all forms of red meat, as they were assumed to be high in fat and cholesterol, and thus detrimental to future health (Hosking, M. and Rogers, J., 1989).

Nutritional and health related concerns at that time lead to a decline in red meat intake by Australians (Fantini, L. and MacDonald, N.A., 1987). Although no scheme exists to measure actual foods consumed by Australians on an annual basis, the Australian Bureau of Statistics' Apparent Consumption figures are utilised to reveal trends in food consumption. These figures reveal that the consumption of beef and veal has decreased over the last seventeen years, while that of poultry has increased (Fantini, L. and MacDonald, N.A., 1987).

In 1976-77, the apparent consumption of beef and veal was 69.1kg/head, while in 1983-84 it was 42.3kg/head, representing a thirty-nine percent reduction (Fantini, L. and MacDonald, N.A., 1987). In 1986-87, it was 39.4kg/head, indicating a forty-three percent reduction since 1976 (Hosking, M. and Rogers, J., 1989). In contrast, the apparent consumption of poultry was 15.7kg/head in 1976-77, and 20kg/head in 1983-84, representing a twenty-seven percent increase (Fantini, L. and MacDonald, N.A., 1987).

In the early 1980's it became necessary for the Australian Meat and Livestock Corporation to initiate promotional campaigns to market red meat to Australians. Extensive market research conducted in 1984-85 (McKinna and others; 1984, Campaign Palace, 1985; cited in Fantini, L., 1990) revealed the many factors which had influenced people's intake of red meat and had lead to its reduced consumption.

Although concern about health was one primary factor, other identifiable factors related to economic factors and lifestyles.

### 2.1.1 ECONOMIC FACTORS

Approximately fifty percent of all Australian beef is exported. Thus trends in the world and Australian economies will always affect the availability and price of red meat on the Australian market (Hosking, M. and Rogers, J., 1989). The world oil crises of the 1970's meant that surplus red meat was available in the mid 1970's. Thus its price was reduced, which probably lead to its high apparent consumption at that time. In comparison, during the early 1970's there were lower apparent consumption figures which were similar to the 1983-84 figures (Walker, D.J., 1988). These figures were indicative of increasing export power, and thus the reduced availability of red meat to Australians, at these times.

Frequent price fluctuations such as these were identified as contributors to the view that beef was expensive and inconsistently priced. Thus, each time its price fluctuated, there was the potential for a reduction in beef intake (Fantini, L. and MacDonald, N.A., 1987).

### 2.1.2 LIFESTYLE FACTORS

A number of lifestyle related factors were identified as contributors to the decline in red meat intake.

**(i)** The perceived ideas that traditional meat cuts were not convenient, and did not offer variety (two components that were identified as important).

**(ii)** A lack of knowledge among consumers about how to successfully prepare a quick and easy (e.g. microwave) red meat meal.

**(iii)** The availability of red meat was hampered by limited retail trading hours, while that of competitive protein sources was not.

**(iv)** The inconsistency in price, and quality of red meats.

**(v)** The growing popularity of ethnic dishes, which generally included minimal red meat (Fantini, L., 1990).

Thus health related concerns and a lack of relevant nutrient data were factors which contributed to the decline in beef intake by Australians. Also involved were economic and lifestyle factors. The fact that in 1983 Australians still consumed a high fat diet (thirty-seven percent of their energy as fat), indicates that influences other than health also were involved (Commonwealth Department of Community Services and Health, 1987).

Although the identification of these factors meant that many of them could be readily addressed, the health debate could not be settled, due to a lack of recent nutrient composition data on Australian meat. English (1987, p.9) supported the need for accurate nutrient composition data when addressing health concerns by stating, "A knowledge of the nutrient content of food is needed for research into the link between diet and disease, and for health education programs to advise the community on food selection to reduce the risk for diet related diseases".

## 2.2 THE APPLICATIONS OF FOOD COMPOSITION DATA

Australian nutrient composition data which is accurate and up to date, is of paramount importance for use in Australia. Food composition data has a variety of uses and many people use these data in their daily lives, including; health professionals, educators, researchers, policy makers, consumers and the media. The applications of food composition data include:

### 2.2.1 THE ASSESSMENT OF DIETARY INTAKE

Dietitians often utilise diet histories to determine an individual's nutrient intake. Dietary surveys are also used to determine nutrient intakes. So as to interpret these intake studies, Dietitians need to use food composition tables (Foote, D., 1990).

### 2.2.2 RECIPE ANALYSIS

The nutrient analysis of recipes is becoming very popular, and is particularly important when providing special diet recipes (e.g. low protein, low sodium). Accurate recipe analyses require the utilisation of accurate and representative food composition data (Foote, D., 1990).

### 2.2.3 RESEARCH

Clinical and epidemiological studies require the use of accurate food composition data (Greenfield, H. and Wills, R.B.H., 1979).

> "The dietary treatment and the management of disease and most quantitative studies in human nutritional research are dependent on these measurements" (Southgate, D., 1990, cited in English, R.M. and Lewis, J.L., 1990, p.246).

This quote indicates the need for an accurate nutrient composition dataset if meaningful research is to be conducted.

### 2.2.4 COMMERCIAL FOOD LISTS

The preparation of commercial food lists for clients on special diets, requires the use of accurate food composition data. These data may be used to provide serving sizes, or an allowed number of exchanges of a particular food for people on special diets (Foote, D., 1990).

### 2.2.5 AN INFORMATION SOURCE FOR THE MEDIA AND CONSUMERS

The increased interest in nutrition and health by these groups means that much nutrient information is supplied to them. This may include product information booklets, recipe books and nutrition advertisements. Whatever the information source, the message contained is based on a review of food composition data (Greenfield, H. and Wills, R.B.H., 1979).

### 2.2.6 AN EDUCATION TOOL

Nutrient composition information is required if decisions about the nutritional value of foods, and their role in the diet are to be considered. This information forms the basis of many nutrition messages including the dietary guidelines; "If you drink alcohol, limit your intake", and "Eat only a moderate amount of sugars and foods containing added sugars" (Department of Health, Housing and Community Services and the Health Department of Western Australia, 1993, p.1). Thus food composition data is the basis on which health promotion recommendations and nutrition education strategies are based (English, R. and Lewis, J., 1991).

### 2.2.7 TO DETERMINE FOOD POLICY

The *Australian Food and Nutrition Policy* aims "To improve health and reduce the preventable burden of diet-related early death, illness and disability among Australians" (Commonwealth Department of Health, Housing and Community Services, 1992, p.12). Objective four of this policy involves the regular monitoring and surveillance of the Australian food system. This is necessary so that the other three objectives can be addressed. These include: (1) Improving the knowledge of Australians about healthy eating, (2) Encouraging community activities to enhance the diets of people who have specific needs, and (3) The incorporation of food and nutrition into policy areas (Commonwealth Department of Health, Housing and Community Services, 1992).

Food composition information is essential if recommendations about healthy food choices are to be made to Australians. Thus, up to date and accurate nutrient composition information is central to the development, and implementation of a National Food and Nutrition Policy.

### 2.2.8 FOOD LABELLING

Nutrient composition studies are essential if a food company endeavours to place a nutrient panel or health claim on its product. In recent years, the growing interest in nutrition by Australians has been associated with an increased number of nutrient panels (food labels) on food produce.

The recently introduced *Nutrition, Education and Labelling Act*, stipulates all processed foods in the U.S.A. must have a nutrition label by May 8, 1994 (DeVries, J.W., 1993). If Australia follows this initiative, food composition studies will become extremely important to the Australian processed foods industry.

A consideration of the many applications of food composition data has revealed its wide usage and importance. It must be highlighted that food composition data are the basis for all of the applications previously outlined. Thus the value of these applications are influenced by the accuracy and representativeness of the nutrient composition values used. The numerous public health applications of these data indicates the importance of Australia having accurate and up to date data available about its national food supply.

## 2.3 A HISTORY OF THE NUTRIENT COMPOSITION OF AUSTRALIAN MEATS

The situation in the early 1980's was that the most recent data, the *Metric Tables of Composition of Australian Foods*, had been published in 1977 (Thomas, S. and Corden, M., 1977), and were a metricated revision of the 1970 tables (Thomas, S. and Corden, M., 1970). These 1970 tables had been a complete revision of the previous *Tables of Composition of Australian Foods* (Osmond, A. and Wilson, W., 1954), but were revised primarily from overseas data, and were not representative of Australian foods. The data sources for these tables included U.S.A. data (Church, C.F. and Church, H.M., 1963; Watt, B.K. and Merrill, A.L., 1963), British data (McCance, R.A. and Widdowson, E.M., 1960), and German data (Souci, S.W. et al., 1962) (English, R., 1981).

Thus accurate and up to date Australian data was non existent at a time when the nutritional value of Australian beef was being questioned. Consumers, the media and health professionals had limited data upon which to base their beliefs, and the data that was available included thirty year old Australian data or twenty to twenty-five year old overseas data.

This lack of appropriate data was further affected by the differing production methods in overseas countries. This resulted in Australian beef being falsely portrayed as a large contributor of fat to the Australian diet. The 1983 National Dietary Survey contradicted these claims. It reported that meat and all meat products provided approximately thirty percent of the total fat intake, with only twelve percent of this being contributed by beef, veal, and lamb (Hosking, M. and Rogers, J., 1989). This survey was based on food composition tables which comprised of fifty percent Australian data, with the remaining data being derived from *McCance and Widdowson's The Composition of Foods* (Paul, A.A. and Southgate, D.A.T., 1978) (English, R., 1990).

## 2.4 <u>METHODS OF BEEF PRODUCTION IN AUSTRALIA AND OVERSEAS</u>

In Australia, production methods result in leaner meat from younger animals. Cattle is slaughtered at twelve to sixteen months of age, with a weight of 320-350 kilograms, whether lot fed (up to ten percent of cattle) or pasture fed (approximately ninety percent of cattle) (Fantini, L., 1988). No significant difference has been found in the fat composition of cattle fed either diet, as Australian cattle are not fed past sexual maturity, when intramuscular fat (marbling) is laid down (Sinclair, A.J. and O'Dea, K., 1987).

In contrast, most cattle in the U.S.A. are lot fed. Cattle usually are slaughtered at twenty to twenty-four months, with a minimum weight of 500 kilograms. Thus cattle produced in the U.S.A. tends to contain more intramuscular fat than cattle produced in Australia (Hosking, M. and Rogers, J., 1989).

These differences in beef production were evident in the late 1970's (Hosking, M. and Rogers, J., 1989). Therefore, while it is evident that Australian beef may have become leaner, the *Metric Tables of Composition of Australian Foods* (Thomas, S. and Corden, M., 1977) which were based on overseas data, were the only source of data available in the early 1980's. It is evident that these data were not representative of the Australian beef available at the time.

## 2.5 THE ANALYTICAL PROGRAMME TO REVISE THE AUSTRALIAN FOOD COMPOSITION TABLES

In the late 1970's, concerns by health professionals about the relationships between diet and disease sparked the need for an accurate, and up to date Australian nutrient dataset. The introduction of many new foods onto the Australian market at this time, with no accompanying nutrient composition data, further stimulated the development of an Australian Food Composition Programme (Greenfield, H. and Wills, R.B.H., 1979).

In 1980, an analytical programme was commissioned to determine the nutrient content of Australian foods (Cashel, K. et al., 1989). The priorities for the programme were:

1. Foods which made a large dietary contribution;
2. Foods for which limited or improper data were available;
3. Primary produce; and
4. Foods for which consumers and dietitians wanted information (English, R., 1990).

Meat fitted all of these criteria and was therefore considered a priority for analysis. In 1982, a funded campaign was initiated to determine the nutrient composition of a range of Australian meats (Cashel, K. and English, R., 1987).

## 2.6 PREVIOUS AUSTRALIAN STUDIES ON BEEF

Thornton, R.F. et al. (1987) studied the fat content of various cuts of lamb, beef and chicken, in their raw and cooked states. The beef cuts studied included twenty-four each of t-bone, rump and blade steaks, and eight topside roasts. Each of these cuts was selected from a local butcher's shop.

The roasts were divided in half for raw and cooked roast analyses, while three strips of meat were selected from each steak. The middle strip was analysed raw, and the other two were analysed in their cooked state (one was grilled and one was pan-fried in a non-stick pan).

Thornton, R.F. et al. (1987) reported that the lean of chicken breast with no skin contained the least fat. However, the lean of the cooked beef contained less fat than the chicken breast with skin, and that both were lower in fat than the lean of the cooked lamb or the chicken drumsticks with skin.

Thornton, R.F. et al. (1987) revealed that for some traditional meat cuts, fat is visible and separable, so the consumer can select the amount of fat eaten. Additionally, the lean of some beef cuts was found to be lower in fat than some chicken cuts. This study also highlighted the positive influence that grilling can have on the fat content of meat. A comparison of the fat content of t-bone, rump and blade steaks after grilling and pan frying (non stick pan with no added fat), indicated that the grilling method allows a greater loss of fat from meat. This study concluded that red meat can be a nutritious part of a daily diet.

Hood, R.L. (1987) studied the cholesterol content of beef rib steaks. Four separate purchases from a Sydney supermarket provided the thirteen thick rib steaks used in the study.

The cholesterol content of the longissimus dorsi muscle, the intramuscular tissue and the subcutaneous fat was determined. It was reported that the contribution of marbling to cholesterol content is not significant. However it was recommended that beef trimmed of visible fat be selected, as the adipose tissue was found to contain seventy percent more cholesterol than the muscular component (Hood, R.L., 1987).

Greenfield, H. et al. (1987) studied the nutrient composition of both raw and cooked samples of beef brisket (corned), chuck steak, fillet steak, hamburger mince, rib steak, rib eye steak, rump steak, silverside (corned, and non-corned) and skirt steak.

The ten samples of each beef cut were purchased over the counter by ten mystery shoppers to ensure the retailers were not aware of the study. The purchases were obtained randomly from Sydney suburbs, across the different socio-economic regions, via a scheme devised by Greenfield, H.

et al., (1987). Seven of the ten samples were bought from butcher's shops and three from supermarkets, reflecting the marketing trends at the time of the study. Each purchase was divided into two lots, one for analysis as raw and one for analysis as cooked.

Prior to analysis in the cooked state, the brisket (corned) and silverside (corned) were boiled separately for 40 minutes, the chuck and skirt steaks were stewed separately for 15 minutes and the hamburger mince was simmered for 25 minutes. Further, the silverside (non-corned) was roasted for 90 minutes and the fillet, rib, ribeye and rump steaks were separately grilled for 10-15 minutes (Greenfield, H. et al., 1987).

The gross composition for each of the raw and cooked samples was determined, except for mince. The lean meat and fat portions for each cut were separately homogenised and re-homogenised, so as to form single composites of each cut for nutritional analysis. Composite samples also were prepared for raw and cooked beef mince.

Although a series of single replicate samples are the optimal sampling procedure, budgetary constraints often limit their use. Single composite samples are prepared by pooling equal amounts of the same cut, but from different outlets, and are an acceptable sampling procedure (Greenfield, H. and Southgate, D.A.T., 1992).

Analytical tests were conducted on the composite samples for each of the raw and cooked beef cuts, so that the nutrient compositions of each cut could be determined. All analyses were conducted in duplicate. Table 2.2 reveals the nutrients analysed and the tests used for their determinations.

**Table 2.2: The Analytical Methods Used, and the Nutrients Determined**

| Nutrient | Analytical Test |
|---|---|
| Weight | Scales |
| Edible Weight | Weight minus dissection loss |
| Moisture | Drying to a constant weight in a vacuum oven at 70°C |
| Fat | Acid hydrolysis, and solvent extraction |
| Ash | Muffle furnace at 550°C |
| Protein | Kjeldahl procedure for nitrogen, and using a protein conversion factor of 6.25 |
| Energy | Applying the factors: Protein 17kJ/g, Fat 37kJ/g |
| Sodium ) | |
| Potassium ) | Dissolved the ash in HCl, and |
| Calcium ) | utilised atomic absorption |
| Magnesium ) | spectrophotometry |
| Iron ) | |
| Zinc ) | |
| Cholesterol | Gas chromatography |
| Fatty Acids | Gas chromatography of methyl esters prepared from chloroform: methanol extract |
| Vitamin B1 | Thiochrome method |
| Vitamin B2 | Fluorometric method |
| Vitamin B3 | Reaction with cyanogen bromide |
| Carotenes | Column chromatography, and analysed colorimetrically |
| Retinol | High pressure liquid chromatography, after saponification, and extraction |

(Greenfield, H. et al., 1987, p.208-211)

This study revealed that the fat content of the beef analysed was fifteen to fifty percent lower, and thus lower in energy, than the data presented in the *1977 Metric Tables of Composition of Australian Foods* (Thomas, S. and Corden, M., 1977). The fat content of the beef cuts in this study were also lower than those in the British (Paul, A.A. and Southgate, D.A.T., 1978) and U.S.A. Food Composition Tables at the time (Anderson, B.A. et al., 1986). The results relevant to the current study are presented in Appendix 1.

Hutchison, G.I. et al. (1987a) conducted a similar study. They analysed the nutrient content of raw and cooked sirloin steak, blade steak (bone in), round steak, topside steak and beef mince during June-July, 1982. This study involved the purchase of nine samples of each beef cut from three retailers in each of the lower, middle and upper socio-economic areas of Sydney. Two samples were obtained from butcher's shops, and one from a supermarket, within each area. The size of the cuts was one kilogram for the roast and 500 grams for the remaining cuts. No more than three cuts were purchased from any one outlet and each item was divided, so that half could be analysed in the raw state and half in the cooked state.

Prior to analysis in the cooked state, the blade, round and sirloin steaks were separately cooked in a vertical griller for 10 minutes and the mince was simmered in water for 20 minutes. Further, the topside roast was cooked (in a dry pan) in a gas oven for 30 minutes at 180-200°C (Hutchison, G.I. et al., 1987a).

The gross composition of all cuts, except mince, was determined. The beef samples for each cut were dissected into their lean meat, bone and fat components. The lean and fat components of each sample were separately homogenised and then composite samples of the raw and cooked lean meat and fat were prepared for analysis.

Separate composite samples of the raw and cooked beef mince also were prepared, via the homogenisation of equal amounts of beef mince from either the raw or cooked mince. Analytical tests were conducted on all of the composite samples so that the nutrient composition of each cut could be determined.

Table 2.3 lists the analytical methods used and the nutrients analysed during this study. Except for the fatty acid and moisture determinations, all analyses were conducted on freeze dried samples and factors were used to convert the data to a fresh weight content. All analyses were conducted in duplicate.

The results of this study, provided in Appendix 2, identified that Australian beef was a good source of protein, zinc, iron, riboflavin and niacin in the diet.

The fat content of the beef was found to be considerably lower than in the *1977 Metric Tables of Composition of Australian Foods* (Thomas, S. and Corden, M., 1977) the British tables, (Paul, A.A. and Southgate, D.A.T., 1978) and the U.S.A. Food Tables, (Watt, B.K. and Merrill, A.L., 1963) indicating that it was appropriate to reinvestigate the nutritional value of Australian beef.

**Table 2.3: The Analytical Methods Used, and the Nutrients Analysed During the Study**

| Nutrient | Analytical Method |
|---|---|
| Weight | Scales |
| Edible Weight | Weight minus dissection loss |
| Moisture | Freeze drying to constant weight and then oven heating (60°C) to constant weight |
| Nitrogen | Kjeldahl procedure, and protein calculated by multiplication by 6.25 |
| Fat | Mixed solvent extraction |
| Cholesterol | Enzymatic, and colorimetric method |
| Fatty Acids | Mixed solvent extraction, and gas chromatography |
| Calcium ) Magnesium ) Zinc ) Iron ) Sodium ) Potassium ) | Wet ashing, and then atomic absorption spectrophotometry |
| Ash | Muffle furnace at 525°C |
| Vitamin B1 | Nobile, Savage and Huber method |
| Vitamin B2 | HPLC Chromatographic method |
| Vitamin B3 | Association of vitamin Chemists Method |
| Retinol | DeVries, Egberg & Heroff Method |
| Energy | Applying the factors: Protein 17kJ/g, Fat 37kJ/g |
| Amino Acids | Beckman Autoanalyser after hydrolysis |

(Hutchison, G.I. et al., 1987b, p.196)

## 2.7 THE 1989 AUSTRALIAN FOOD COMPOSITION TABLES

Data provided by these studies, and particularly those by Greenfield, H. et al. (1987) and Hutchison, G.I. et al. (1987a) were the basis for the beef data published in the 1989, *Composition of Foods, Australia* (Cashel, K. et al., 1989). This research provided up to date data on the gross and nutrient compositions of Australian beef cuts.

Gross and nutrient composition data (twenty three nutrients) were collected during these studies so that future revisions need only obtain gross composition information to update these data on beef composition (Cashel, K., 1990).

The nutrient composition data for each cut were presented in a number of forms, including: as the lean meat portion only; as the lean meat and fat portion (as purchased); as fifty percent trimmed; and as seventy-five percent trimmed of fat. These data are provided in Appendix 3. The nutrient compositions of the fat only component of each cut were presented in Greenfield, H. et al. (1987) and Hutchison, G.I., et al. (1987a). The nutrient compositions of the lean meat only and the fat only components, as well as the lean meat and fat components combined, were determined so that the fat content of the beef could be represented at varying trim levels. In addition, these data could be used in the future, thus minimising the use of resources when updating the data (Cashel, K., 1990).

The 1983 National Dietary Survey indicated that seventy percent of beef consumed is trimmed of fat (Commonwealth Department of Community Services and Health, 1986). However, it did not indicate to what extent the fat was trimmed. Thus the fat content of the beef cuts when trimmed of fifty percent fat and seventy-five percent fat were determined, so as to provide consumers and health professionals with further information on the fat composition of trimmed beef cuts. However, these figures were arbitrarily determined by calculation, not by analysis (Cashel, K. et al., 1989). Therefore, in using these figures people need to subjectively decide to what level particular individuals trim their beef, as a range of retail trimmed beef cuts were not available at the time of these studies.

While these figures provide an indication of the fat content of beef trimmed to various levels, these data could not be as accurately applied to food intake data as the lean meat and fat data (as purchased) published in the *Composition of Foods, Australia* (Cashel, K. et al., 1989). This was because the nutrient compositions of the lean meat and fat components of each beef cut had been determined by analysis, while the nutrient compositions of the fat trimmed beef cuts had been determined by computation, without knowledge of the actual level of consumers' fat trimming.

The publication of the *Composition of Foods, Australia* (Cashel, K., et al. 1989) meant that accurate and up to date data could be provided to Australians. These data enabled health professionals, the media and the Australian Meat and Livestock Corporation to promote the nutritional value of Australian beef (Fantini, L., 1990). However, by the time these complete data were published in 1989, a new range of lean beef had entered the Australian marketplace.

## 2.8 THE INTRODUCTION OF A RANGE OF LEAN BEEF CUTS

In 1987, the Australian Meat and Livestock Corporation responded to consumer demands for leaner and more convenient meat cuts by launching a range of National Heart Foundation approved beef cuts. These fourteen beef cuts were trimmed of all visible selvedge fat (Table 1.1).

Although comprehensive nutrient compositions were not determined for these beef cuts, they were given the "tick of approval" because the lean meat only component of the comparable cuts, published in Greenfield, H. et al. (1987) and Hutchison, G.I. et al. (1987a) had a fat content of less than ten percent, and a sodium content of less than 120mg per 100 grams. These are the cut off levels of fat and sodium for National Heart Foundation approval (AMLC, 1992; National Heart Foundation of Australia, 1992). Further, a study conducted by the Australian Government Analytical Laboratories (N.S.W.) in 1987, determined the fat, cholesterol and sodium contents of these beef cuts, and found that they met the criteria stipulated for

National Heart Foundation Approval (AMLC, Personal Communication, 1993). Therefore these cuts which are still awaiting detailed nutritional analysis, were promoted as a healthy meat choice. The National Heart Foundation "tick of approval" enabled consumers to identify the beef as lean, a feature which is important to many of today's consumers (Dangar Research, 1992).

Similarly in the United States of America, the demand for meat is no longer influenced by price alone. While taste was reported as a primary reason for people purchasing beef, price, fat, and cholesterol contents also were identified as three important factors which determined their purchase of beef (Smith, G.C. et al., 1987). The *National Consumer Retail Beef study* revealed that half of the shoppers surveyed preferred the *choice* grade beef, due to its taste. In contrast, the other half preferred the *good* grade (sometimes labelled *select*) as it was leaner and appeared more nutritious and appetizing (Smith, G.C., et al., 1987).

It appears that many consumers in the United States of America also are requesting and purchasing lean meat. A United States Department of Agriculture Survey found that the fat content of retail beef cuts had decreased by twenty-seven percent between 1976 and 1988 (Anon., 1988).

The beef production industry and retailers have responded to consumer demands by providing leaner (*select* grade) beef (trimmed to one quarter of an inch external fat) for health conscious individuals, in addition to the traditional *choice* grade cuts (Sweeten, M.K. et al., 1990). The *National Beef Market Basket Survey* revealed that forty-two percent of beef cuts had no selvedge fat and the average thickness of external fat for all retail cuts was 0.11 of an inch (Savell, J.W. et al., 1988).

The nutrient compositions of the quarter of an inch external fat beef cuts were determined, using comparable methods to the Australian studies, and were published in 1990 (Anderson, B.A. and Hoke, I.M., 1990; Savell, J.W., 1990). It is evident that consumers in the United States of America, like Australia, are becoming increasingly concerned about their health and are thus encouraging producers and retailers to provide leaner cuts of beef.

## 2.9 RED MEAT, FAT AND THE HEALTH OF AUSTRALIANS IN 1992

In nations where diet related diseases are prevalent, people are becoming increasingly concerned about their health and particularly about the effects of excessive fat intake. In Australia, available evidence links the overconsumption of food, especially particular nutrients (e.g. fat, salt and sugar) to the major causes of death in the country. These include; cardiovascular disease, cancer and cerebrovascular disease (Darnton-Hill, I. and English, R., 1990; National Health and Medical Research Council, 1992).

It is highly appropriate that Australians are concerned about their fat intake. The *1989 Risk Factor Prevalence Study* revealed that fifty percent of men (aged 20-69 years) and thirty-five percent of women (aged 20-69 years) are either overweight or obese. Additional concerns are evident as one sixth of all Australian adults have hypertension and more than two fifths of adults have elevated cholesterol levels (Thomson, N.J., 1992).

In 1992, the *Australian Dietary Guidelines* were updated so that they were appropriate to the needs of Australians in the 1990's (Commonwealth Department of Health, Housing and Community Services, 1992). Table 2.4 reveals the ten dietary guidelines, which now include recommendations about the minerals calcium and iron. It must be highlighted that these guidelines are listed in order of importance. Thus, "Eat a diet low in fat and in particular, low in saturated fat", is guideline number three (Department of Health, Housing and Community Services, and the Health Department of Western Australia, 1993, p.1). It is evident that concern over the intake of fat by Australians, particularly saturated fat, and its relationship to disease has meant that a guideline reducing its consumption is considered a high priority.

**Table 2.4: The Dietary Guidelines for Australians (1993)**

" **1.** Enjoy a wide variety of nutritious foods.
**2.** Eat plenty of breads and cereals (preferably wholegrain), vegetables (including legumes), and fruits.
**3.** Eat a diet low in fat and, in particular, low in saturated fat.
**4.** Maintain a healthy body weight by balancing physical activity and food intake.
**5.** If you drink alcohol, limit your intake.
**6.** Eat only a moderate amount of sugars, and foods containing added sugars.
**7.** Choose low-salt foods and use salt sparingly.
**8.** Encourage and support breastfeeding.
**9.** Eat foods containing calcium. This is particularly important for girls and women.
**10.** Eat foods containing iron. This is particularly important for girls, women, vegetarians and athletes"

(Department of Health, Housing and Community Services and the Health Department of Western Australia, 1993, p.1)

In 1992, the apparent consumption of beef by Australians was 35.7 kilograms per head, a nine percent reduction since 1986-87 (AMLC, 1993b). Although some of this decrease could be attributed to increased trimming at the retail level, it also indicates a further reduction in red meat intake by Australians. This is reflected by the six percent increase in the volume of poultry traded since 1991 (AMLC, 1993b).

Recent market research has indicated that Australian women are still concerned about the role of red meat in the Australian diet (Dangar Research, 1992). A number of factors were associated with people avoiding red meat. These included:

**(1)** Fashion - vegetarianism was becoming popular;

**(2)** Image - red meat was still perceived by many as masculine, and heavy;

**(3)** Lifestyle - variety, and convenience were indicated as important, as was the use of ethnic recipes; and

**(4)** Health - people were still uncertain about the dietary value of red meat and requested more detailed nutritional information. 'Lean' was found to be an important marketing term for health conscious consumers (Dangar Research, 1992; Tolisson, B., 1993).

It is evident that in 1992 Australians were still concerned about their fat intake and particularly the contribution by red meats. A national survey in 1993 indicated that thirty percent of Australian retailers offer NHF approved beef cuts (AMLC, 1993a). Although these beef cuts can be promoted as trimmed of fat and as good sources of protein, iron, zinc and B-vitamins, these promotions could be further supported, and consumer's concerns addressed, if comprehensive nutrient composition data on these cuts were available.

In order to address consumer concerns over the relationships between diet and disease, an accurate and up to date food composition resource is paramount (Holden, J.M. and Davis, C.S., 1993). Windham, C.T. et al. (1987) reported that nutritionists are regularly updating information on food composition and the relationships between diet, health and disease so as to educate the public. It also is evident that social and technological changes and marketing have influenced retail meat provision in Australia (Greenfield, H. and Wills, R.B.H., 1979).

So as to provide up to date data and to allay consumer concerns, it is very evident that the nutrient compositions of the 1987 range of fat trimmed beef cuts need to be determined. These data are necessary so that health professionals, consumers and the media can be made aware of the nutrient content of these new beef cuts, to ensure that their place in the diet is appropriately portrayed.

Prior to discussing the preferred methodology for such a study, another study will be discussed that was conducted on untrimmed Australian beef and lamb cuts in 1992. Watson, M.J. et al. (1992) studied eight beef cuts and three lamb cuts from four supermarkets (two of each from two Australian chains) in Victoria. Two supermarkets were located in low socio-economic areas and two were located in high socio-economic areas.

The cuts of lamb and beef analysed included midloin chops, forequarter chops, leg of lamb, topside steak, blade steak, sirloin steak, rump steak, rolled rib roast, mince, hamburger mince and sausage mince. Two packages of each cut were randomly selected from supermarket fridges, on five occasions, over thirty-five weeks.

The purpose of the study was to determine the fat content of these cuts. The study aimed to compare the fat content between samples of the same cut by analysing replicate samples. Previous studies (Greenfield, H. et al., 1987, and Hutchison, G.I. et al., 1987a) had used composite samples for each cooked and raw beef cut.

An automated analyser was used to determine the fat content of each sample, for each cut, in duplicate. This study reported that the fat content of the same beef cuts was highly variable, although there was no evidence that the fat content varied significantly between supermarket chain or socio-economic area.

More than seventy-five percent of the samples analysed for rump steak, topside, mince and hamburger mince contained less fat than was reported in the *Composition of Foods, Australia* (Cashel, K. et al., 1989). Thus the implementation of regular programmes to monitor the nutrient compositions of retail meats was recommended. Further, single replicate samples were recommended for analysis, and large metropolitan cities were recommended for sampling.

## 2.10 METHODOLOGICAL CONSIDERATIONS WHEN CONDUCTING FOOD COMPOSITION STUDIES

In order to conduct nutrient composition studies which provide accurate and meaningful data, researchers need to consider the study methodology very carefully. Specific components of the methodology which require particular consideration include: (1) the sampling plan, (2) the preparation of the samples for analysis, (3) the prioritisation of nutrient analyses and (4) the analyses used to determine nutrient content (Cashel, K., 1990).

The considerations needed at each of these stages will be highlighted and the methods used by previous researchers summarised.

### 2.10.1 THE SAMPLING PLAN

The aim of sampling is, "To obtain an analytical sample that is representative of the foods available to, or consumed by the population concerned" (Greenfield, H., and Southgate, D.A.T., cited in Cunningham, J.H., 1990, p.16). In order to provide meaningful results, it is paramount that the sample is representative of the population studied.

Food items which can vary greatly between locations need careful consideration when sampling. Non factory produced goods, such as meat, may have variable nutrient compositions, especially between areas of different socio-economic status. Usually ten samples of each cut of such items are purchased so as to gain a representative sample (Cunningham, J.H., 1990). Further, the purchases are made from supermarkets and butchers, according to meat marketing trends.

Greenfield, H., et al. (1987) purchased ten samples of each beef cut, one from each of the ten different socio-economic areas across Sydney. The supermarket and butcher retailers were unaware of the study, so as not to bias the results. Hutchison, G.I. et al. (1987a), purchased nine samples of each beef cut from three socio-economic areas across Sydney, so as to reflect a representative sample of the beef supply.

In contrast, Thornton, R.F. et al. (1987), purchased all of their samples from butcher shops, while Hood, R.L. (1987) and Watson, M.J. et al. (1992), purchased all of their beef cuts from supermarkets. As these methods do not represent the range of meat available to consumers across a metropolitan area, the sampling method of Greenfield, H. et al. (1987) is preferred.

### 2.10.2 THE PREPARATION OF THE SAMPLES FOR ANALYSIS

The individual nutrient analyses of food involves withdrawing small subsamples from the food sample. This requires that all samples are individually homogenised to ensure that results representative of the original sample are obtained (Cunningham, J.H., 1990).

Samples of each particular food item may be made into a single composite or replicate samples for analysis. The formation of single replicates of each sample from a particular food item is the preferred approach as it allows variation between samples from different locations to be determined (Watson, M.J. et al., 1992). However, it is also very expensive. Thus a single composite for each type of food being investigated often is used. It is considered representative of the food being analysed if it is prepared from a homogeneous mass of each sample and then homogenised to form a single composite sample of the food item (Greenfield, H. and Southgate, D.A.T., 1992).

The use of duplicate samples also are considered important, so that any significant variation can be detected and the analyses reconducted if necessary. The methods utilised by Greenfield, H. et al. (1987), Hutchison, G.I. et al. (1987a) and Watson, M.J. (1992), appropriately fulfill these sample preparation criteria.

### 2.10.3 THE PRIORITISATION OF NUTRIENT ANALYSES

The handling and storage of foods affects their nutrient composition. Appropriate methods to limit oxidation by air, heat and light are necessary. The sequencing of nutrient analyses is paramount. The moisture, fat and water soluble vitamins are the highest priority for immediate analysis, so as to suppress these effects. The minerals may be investigated later as long as the samples are covered and frozen prior to analysis (Scheelings, P. and Buick, D., 1990).

### 2.10.4 THE ANALYSES USED TO DETERMINE NUTRIENT CONTENT

If results representative of the food being analysed are to be produced, appropriate and valid analytical methods need to be used to determine nutrient compositions of foods (DeVries, J.W., 1993). The consistency of methods used for analysis also are important if food composition data from different studies are to be compared. Thus methods similar to those used by Greenfield, H. et al. (1987) and Hutchison, G.I. et al. (1987a) will be used. Some methods used in the current study will be slightly different to these previous studies, as technology has enabled new standard methods to be introduced (Cashel, K., 1990).

This discussion has revealed the number of considerations that need to be made when planning a food composition study. The usefulness and representativeness of the final results depend on such methodological components as the sampling procedure, the sample preparation, the prioritisation of analyses, storage of samples and the particular analyses used to determine the nutrient contents.

## 2.11 THE NEED FOR UP TO DATE DATA ON THE NUTRIENT COMPOSITIONS OF THE FOURTEEN NATIONAL HEART FOUNDATION APPROVED BEEF CUTS

The decreased consumption of beef by Australians in 1992, and market research indicating consumers views on beef, combined with the emphasis on reducing fat in the 1992 dietary guidelines, indicates that up to date data on the range of lean beef cuts introduced in 1987 is necessary.

It is evident that consumer demands led to the launch of this range of National Heart Foundation approved beef cuts onto the Australian market. Recent research indicates that Australian consumers are seeking reassurance about the nutritional value of Australian meat, and want more detailed nutritional information, as they become more informed about the relationships between diet, health and disease.

This discussion has emphasised that previous concerns about diet and health by Australians, resulted in major revisions of Australian nutrient composition data, and the publication of the *Composition of Foods, Australia* (Cashel,

K. et al., 1989). It is evident that this publication was the first complete revision of Australian nutrient composition data since 1970, and essentially since 1954. Prior to this, Australians had utilised outdated and primarily overseas nutrient composition data (Cashel, K., 1989). Problems involved with the use of such data include, not only the age of the data, and the differing food production methods in overseas countries, but also the different food naming systems utilised in overseas countries (Klensin, J.C., 1993).

One recommendation of the 1989 revision was that regular updates would be provided so that adequate and accurate Australian data would always be available for Australians (Cashel, K. et al., 1989). Thus, in 1990-1991, the priorities for analysis were: new foods which had entered the market place, ethnic foods and mixed dish meals (English, R.M. and Lewis, J.L., 1990).

However, Australians, many of whom are concerned about their fat and red meat intake, are still waiting for detailed nutritional information about the range of lean beef cuts launched in 1987. The data gained by analysing these beef cuts would contribute to the National nutrient composition dataset. They would be published in the *Food Composition Tables*, so that consumers, health professionals and the media could access them and use them for promotional and educational activities.

# CHAPTER THREE

# MATERIALS AND METHODS

## 3.0 MATERIALS AND METHODS

Food composition data needs to be regularly reviewed and updated. It is important that consistent and suitable methods are used, so that accurate data can be provided. The current study used similar methodology to the previous Australian beef studies by Greenfield, H. et al. (1987) and Hutchison, G.I. et al. (1987a).

A number of professionals were commissioned to contribute to the current study so that the statistical, analytical and mathematical methods used would enable the results provided to be representative of the National Heart Foundation (NHF) approved beef cuts available in Australia today. Throughout this section, the materials and methods used by each of these professionals will be highlighted.

The materials and methods necessary to complete this study include:

**(1)** The sample selection of the beef purchases;

**(2)** The purchase and transport of the beef purchases;

**(3)** The laboratory handling and sample preparation of the beef purchases;

**(4)** The attainment of the gross compositions of thirteen, raw, NHF approved beef cuts (excluding lean beef mince);

**(5)** The determination of the nutrient compositions of the thirteen NHF approved beef cuts, in their raw and cooked forms, by computations from previous studies; and

**(6)** The determination by analysis of the nutrient compositions of raw and cooked, NHF approved beef mince.

## 3.1 THE SAMPLE SELECTION OF THE MEAT PURCHASES

A Consultant Statistician from the Australian Bureau of Statistics planned the sample selection, so that it would be representative of the Sydney Metropolitan area. His complete report is provided in Appendix 4. This section will summarise the sampling plan and how it was utilised to purchase the meat samples.

Three components comprised the sample selection. They were:

(1) The selection of the socio-economic areas across Sydney;

(2) The selection of the retail outlets; and

(3) The allocation of the beef cuts to the selected retail outlets.

### 3.1.1 THE SELECTION OF THE SOCIO-ECONOMIC AREAS ACROSS SYDNEY

The Urban Index of Relative Socio-Economic advantage was used to rank Sydney's thirty-seven local government areas into their socio-economic order (Australian Bureau of Statistics, 1986).

Systematic sampling was used to select ten areas, each consisting of one or more local government areas in the Sydney Metropolitan area. This method involved determining a random starting point in the ordered list of local government areas and then using a fixed skip interval to select the areas. This ensured the selection of areas from the different socio-economic areas of Sydney.

### 3.1.2 THE SELECTION OF THE RETAIL OUTLETS

A total of five supermarkets and butcher shops were randomly selected within each of the ten areas, using details gained from the Australian Meat and Livestock Corporation's database. So as to reflect national meat marketing trends, forty percent of the selected retail outlets were supermarkets and sixty percent were butcher shops (AMLC, 1993b).

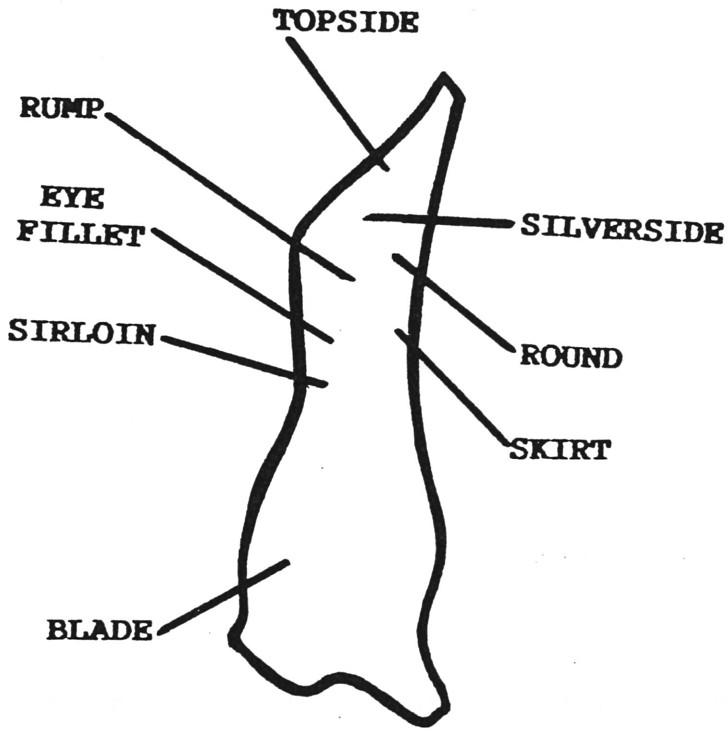
### 3.1.3 THE ALLOCATION OF THE BEEF CUTS TO THE SELECTED RETAIL OUTLETS

Table 3.1 lists the fourteen NHF approved beef cuts that were purchased, their cut code and their purchase weights. Figure 3.1 illustrates the location of these lean beef cuts on the beef carcass. A sample of each of the fourteen cuts was purchased in each of the ten socio-economic areas. Ten anonymous shoppers purchased 150 beef samples (20 samples of beef mince were purchased) on one morning in May 1993.

**Table 3.1: The Lean Beef Cuts to be Analysed, Their Cut Codes and Purchase Weights**

| Cut Code | NHF Approved Beef Cut | Number of Purchases | Approximate Quantity of Raw Meat Purchased Per Sample | Total Estimated Quantity of Meat Purchased |
|---|---|---|---|---|
| A | Eye Fillet Steak | 10 | 250g | 2.5kg |
| B | Eye Fillet Roast | 10 | 500g | 5.0kg |
| C | Skirt Steak | 10 | 250g | 2.5kg |
| D | Round Steak | 10 | 250g | 2.5kg |
| E | Rump Steak | 10 | 250g | 2.5kg |
| F | Boneless Blade Steak | 10 | 250g | 2.5kg |
| G | Boneless Sirloin Steak | 10 | 250g | 2.5kg |
| H | Topside Steak | 10 | 250g | 2.5kg |
| I | Corner Cut Topside Roast | 10 | 1000g | 10.0kg |
| J | Topside Strips | 10 | 250g | 2.5kg |
| K | Topside Cubes | 10 | 250g | 2.5kg |
| L | Mince | 20 | 250g | 5.0kg |
| M | Silverside Roast | 10 | 1000g | 10.0kg |
| N | Silverside Minute Steak | 10 | 250g | 2.5kg |

**Figure 3.1: The Location of the NHF Approved Beef Cuts on the Beef Carcass.**




(Modified from Greenfield, H. et al, 1987, p.208)

A maximum of three types of beef cuts were purchased from any one retail outlet. The cut types were randomly allocated to the selected supermarkets and butchers within each of the ten areas. Table 3.2 details the allocation of the beef cuts to the outlets, in each of the ten areas.

**Table 3.2: The Allocation of Beef* Cuts to Retail Outlets**

| | LGA 1 | LGA 2 | LGA 3 | LGA 4 | LGA 5 |
|---|---|---|---|---|---|
| Outlet 1 | LIE | EDK | CHI | GNJ | GD |
| Outlet 2 | CM | CF | JNM | KCD | MFJ |
| Outlet 3 | FKJ | NHI | GB | HMF | BLI |
| Outlet 4 | DGA | LBJ | LEK | IB | KNC |
| Outlet 5 | BNH | MGA | ADF | AEL | AEH |

| | LGA 6 | LGA 7 | LGA 8 | LGA 9 | LGA 10 |
|---|---|---|---|---|---|
| Outlet 1 | EJG | LEN | BEL | KJA | ELM |
| Outlet 2 | HNC | BAD | HD | MFB | AHJ |
| Outlet 3 | FM | HKG | AGJ | EGN | NCG |
| Outlet 4 | IKA | CF | NIK | LC | DI |
| Outlet 5 | BLD | JIM | FCM | DJH | BKF |

(Thompson, M.,1993, Unpublished Report - Appendix 4)

* Beef cuts are represented by a cut code A → N, as detailed in Table 3.1.

## 3.2 THE PURCHASE AND TRANSPORT OF THE MEAT PURCHASES

Each of the ten anonymous shoppers purchased their fourteen beef cuts on one morning, according to the scheme outlined in Table 3.2. The purchased beef samples were placed in labelled plastic bags, put into labelled retailer bags and then placed in a chilled *Esky* for transport to an inner city meat warehouse.

On arrival, each *Esky* was unpacked, the beef cuts were identified by butchers, cryovac packaged, labelled and then packed into chilled *Eskies*. The chilled *Eskies* were flown to Adelaide on the afternoon of their collection. They arrived at the Australian Government Analytical Laboratories (AGAL), in Seaton at night. The Australian

Government Analytical Laboratories are used by the National Heart Foundation for their food approval programmes (Haddy, B., 1990), and also by the National Food Authority for its food analysis programme (Cashel, K., 1989). Thus it was the most appropriate laboratory for this study.

## 3.3 THE LABORATORY HANDLING AND SAMPLE PREPARATION OF THE MEAT PURCHASES

The analysts at the Australian Government Analytical Laboratories determined the gross compositions of the thirteen raw, NHF approved beef cuts, and the nutrient compositions of the raw and cooked NHF approved beef mince. Their complete report is provided in Appendix 5. This section summarises the methods used to determine the gross and nutrient compositions of these raw and cooked NHF approved beef cuts.

On arrival at the laboratory, the beef samples were stored in the refrigerator. Each beef sample was unpacked and individually labelled the next morning.

### 3.3.1 THE DETERMINATION OF THE GROSS COMPOSITIONS OF THE THIRTEEN RAW, NHF APPROVED BEEF CUTS

Each raw sample was initially weighed. Next, the ten samples for each of the thirteen cuts (excluding lean beef mince) were individually separated into their lean meat, fat, bone and gristle portions. Each of the these portions were weighed for each sample and the dissection loss for each was calculated.

A number of workers dissected similar types of meat so that the determinations of gross composition could be conducted in a time efficient manner. To minimise deterioration, the samples were retained in their cryovac packs or covered with foil when they were not being prepared.

The gross composition of each of the thirteen raw NHF approved beef cuts was determined by calculating the mean from the ten samples for each beef cut.

### 3.3.2 THE PREPARATION OF THE RAW AND COOKED NHF APPROVED BEEF MINCE SAMPLES

The gross composition of mince could not be determined, as it could not be separated into lean meat, fat, gristle and bone components. A complete nutritional analysis was required for both the raw and cooked NHF approved beef mince, to determine its nutrient composition.

Two sets of ten samples (each sample containing 250g raw, NHF approved beef mince) were purchased and sent to AGAL for analysis. One set of the ten samples was mixed individually, then equal amounts of each sample were added to form a raw composite sample. This sample was homogenised for analysis, using a *DAMPA CT 35 cutter.*

The second set of ten samples was used to determine the nutrient composition of cooked NHF approved beef mince. Each of the ten samples were mixed individually and equal amounts of each sample was added to a non stick pan. After dry frying until a colour change occurred, the ten cooked beef mince samples were homogenised by a *DAMPA CT 35 cutter*, to prepare a cooked composite sample for nutrient analysis.

The raw and cooked composite samples were labelled, and stored in polycarbonate screw top jars at -18°C until they were analysed. A series of reserved samples also were frozen.

### 3.3.3 THE DETERMINATION OF THE NUTRIENT COMPOSITIONS OF THE RAW AND COOKED NHF APPROVED BEEF MINCE

Prioritisation of the order of analyses was considered important as all determinations are affected by decomposition. Certain determinations are particularly influenced by exposure to light, heat and oxidation (Cunningham, J.H., 1990). The determinations of moisture content were initiated on the day after the samples were prepared. The quantities of water and fat soluble vitamins were then determined, followed by the mineral analyses. The methods of analysis used during the current study are reported in Appendix 5, and Lewis, J.L. et al., 1993.

The moisture contents of the raw and cooked composite samples were determined by drying in an oven at 102°C until they maintained a constant weight. A soxhlet extraction with diethyl ether for sixteen hours, followed by drying of the samples to a constant weight, was used to determine the fat contents of the composite samples. The Kjeldahl method was used to determine the total nitrogen content, while ignition in a muffle furnace at 550°C was used to determine the ash content of the raw and cooked composite samples.

The riboflavin and thiamin contents were determined by extraction with acid and enzymatic hydrolysis, followed by reverse phase high pressure liquid chromatography and fluorescence. Vitamin B-12 was extracted with an acetate buffer and determined by a microbiological assay, while Vitamin B-6 was extracted with acid and determined via microbiological assay.

Hydrolysis with alcoholic potassium hydroxide, followed by petroleum ether allowed the cholesterol to be extracted from the samples. The addition of acetic anhydride in pyridine at 80°C allowed cholesterol acetate to be liberated, which was determined by capillary gas chromatography.

The sodium and potassium contents were determined by flame atomic absorption spectrophotometry. The magnesium, iron and zinc contents also were individually determined by atomic absorption spectrophotometry, after being dried in a muffle furnace at 500°C and being treated with dilute nitric acid.

Phosphorous was determined by colorimetry, using the molybdo-vanadate reagent and a visible spectrophotometer at 460nm, after being dry ashed in a muffle furnace at 500°C and dissolved in dilute nitric acid. Calcium was determined by flame absorption spectrophotometry, after being dried and dissolved in dilute nitric acid.

Reverse phase high pressure liquid chromatography was used to determine the Vitamin C content of the raw and cooked composite samples. Petroleum ether was used to extract retinol, after the samples had been hydrolysed with alcoholic potassium hydroxide. Reverse phase high pressure liquid chromatography and an ultraviolet detector at 325nm were used to determine the retinol content after the extracts were dried and dissolved in methanol. B-carotene was determined for each composite sample using the same extract, with detection at 450nm.

These methods allowed the gross compositions of the thirteen raw, NHF approved beef cuts, and the nutrient compositions of the raw and cooked lean beef mince to be determined. Many of these analyses were conducted in duplicate. The use of standard reference materials, control samples and the ongoing quality assurance program at the laboratories, ensure that the data gained are accurate.

## 3.4 THE METHODS OF COMPUTATION USED TO DETERMINE THE NUTRIENT COMPOSITIONS OF THE THIRTEEN NHF APPROVED BEEF CUTS

A Dietitian from the National Food Authority was commissioned to determine methods of computation, so that the nutrient compositions of the thirteen NHF approved beef cuts could be determined, in their raw and cooked forms (excluding lean beef mince). Her report is provided in Appendix 6. This section will detail the methods used to determine the nutrient compositions of the thirteen raw and cooked NHF approved beef cuts.

### 3.4.1 THE ORIGIN OF THE GROSS COMPOSITION AND NUTRIENT COMPOSITION DATA

The current study provided nutrient composition data for NHF approved beef mince (raw and cooked) and gross composition data for the thirteen raw, NHF approved beef cuts. The *Composition of Foods, Australia* (Cashel, K. et al., 1989) was the source of the gross and nutrient composition data used for the computations in this study. The beef data published in these tables are primarily from the studies by Greenfield, H. et al. (1987) and Hutchison, G.I. et al. (1987a), which were conducted between 1982 and 1986.

The nutrient compositions of the lean meat, and the lean meat and fat from these studies were published in the *Composition of Foods, Australia* (Cashel, K. et al., 1989) while the nutrient compositions of the fat components were not. However, this information was available from Greenfield, H. et al. (1987), and Hutchison, G.I. et al. (1987a). The phosphorous content of the beef cuts was gained from the NUTTAB 1991-92 database (Lewis, J. and Holt, R., 1991). A series of vitamin and mineral analyses, conducted by the Department of Community Services and Health were the source of these data (English, R.M. and Lewis, J.L., 1990).

The factors used for the calculation of the niacin equivalents, retinol equivalents, the lipid conversion factors for fatty acids, and energy content were those used in the *Composition of Foods, Australia* (Cashel, K. et al., 1989).

### 3.4.2 THE CALCULATION OF THE NUTRIENT COMPOSITIONS OF THE THIRTEEN RAW, NHF APPROVED BEEF CUTS

The gross composition data for the thirteen raw, NHF approved beef cuts were used to determine the relative proportion of the lean meat to fat content for each cut. The dissection loss and gristle were disregarded for each cut, as it was not possible to accurately determine which components comprised these portions, even though they could be eaten.

The edible portion was defined as consisting only of the lean meat and fat components. The percentage contribution of the lean meat and the fat components to the edible portion were determined for each NHF approved beef cut.

These data were separately applied to the nutrient composition data for the lean meat, and fat components of the comparable cuts, studied by Greenfield, H. et al. (1987), and Hutchison, G.I. et al. (1987a), and published in Cashel, K. et al. (1989). The complete nutrient composition of each of the thirteen lean beef cuts was determined by adding together the nutrient composition data which were calculated separately from the lean meat and the fat components of the beef from previous studies, via the application of the lean meat and fat percentage contributions.

### 3.4.3 THE CALCULATION OF THE NUTRIENT COMPOSITIONS OF THE THIRTEEN COOKED, NHF APPROVED BEEF CUTS

Gross compositions were determined for the thirteen lean beef cuts in their raw state. However, no data were available for these cuts in their cooked state. The relative amounts of lean meat and fat in these beef cuts needed to be determined after cooking if the cooked nutrient compositions were to be determined.

The theoretical proportion of lean meat to fat can be determined from the gross composition data of comparable cooked cuts. Beef cuts which were from the most comparable location on the carcass and which utilised the AMLC recommended cooking method for the lean beef cut, were used to calculate the loss of lean and fat on cooking. Table 3.3 details the comparable cut and cooking method used to determine losses on cooking. The comparable cut used to determine the loss of lean meat and fat for topside strips was stir fried trim lamb, as previous studies did not analyse topside strips, and this cooking method is recommended for this beef cut (Sadler, M. et al., 1993).

**Table 3.3: The Comparable Cuts, and the Cooking Methods Used to Determine the Losses on Cooking for the NHF Approved Beef Cuts**

| NHF Approved Beef Cut | Comparable Cooked Cut | Recommended Cooking Method |
|---|---|---|
| Eye fillet steak | Fillet steak | grilled |
| Eye fillet roast | Silverside roast | roasted |
| Rump steak | Rump steak | grilled |
| Silverside steak | Fillet steak | grilled |
| Silverside roast | Silverside roast | roasted |
| Skirt steak | Skirt steak | stewed |
| Blade steak | Blade steak | grilled |
| Round steak | Skirt steak | stewed |
| Sirloin steak | Sirloin steak | grilled |
| Topside steak | Skirt steak | stewed |
| Topside roast | Silverside roast | roasted |
| Topside strips | Lamb, stir fry* | stir fried |
| Topside cubes | Skirt steak | stewed |

(Lewis, J., 1993, Unpublished Report - Appendix 6)

The cooking losses for the individual lean meat and fat portions of the comparable cuts were determined separately from the fat and moisture contents of the lean and the fat components. Figure 3.2 details the formula that was used for these computations.

**Figure 3.2: The Formula Used to Determine the Losses of Lean Meat and Fat on Cooking.**

$$x = \frac{100\,[(\%\text{ moisture}_r + \%\text{ fat}_r) - (\%\text{ moisture}_c + \%\text{ fat}_c)]}{100 - (\%\text{ moisture}_c + \%\text{ fat}_c)}$$

where:

x - is the % cooking loss of the individual component based on changes in the moisture, and fat content

r - is the raw lean (or fat) component

c - is the corresponding cooked lean (or fat) component

(Lewis, J.L. et al., 1993, p.S15)

The percentage loss of lean meat and percentage loss of fat was determined for each cut. These percentages were applied to the percentage contribution of the lean meat and fat data gained from the gross composition of the raw cuts. In this way the derived percentage contribution of the lean meat and fat to the cuts after cooking were determined. These data were then separately applied to the cooked nutrient data (lean meat, and fat compositions) from previous studies to determine the nutrient compositions of the thirteen cooked, NHF approved beef cuts.

# CHAPTER FOUR

# RESULTS

# 4.0 RESULTS

The gross and nutrient composition data gained from the current study will be outlined in this section. Components of these data will be compared and contrasted to the data obtained from previous Australian beef studies (Greenfield, H. et al., 1987, and Hutchison, G.I. et al., 1987a) published in the *Composition of Foods, Australia* (Cashel, K. et al., 1989). Further, the current data will be compared to the most comparable U.S.A. beef cuts published in the *Composition of Foods: Beef Products. Raw, Processed, Prepared* (Anderson, B.A. and Hoke, I.M., 1990).

Although this study aimed to determine the nutrient compositions of all fourteen National Heart Foundation (NHF) approved beef cuts, the primary reason for its initiation was to determine the fat contents of the range of NHF approved beef cuts available in Australia today. Therefore the fat contents of the NHF approved beef cuts, previously studied untrimmed Australian beef cuts, and previously studied U.S.A. trimmed beef cuts will be compared in this section, and the nutritional value of Australian lean beef will be highlighted.

## 4.1 THE GROSS COMPOSITIONS OF THE THIRTEEN RAW, NHF APPROVED BEEF CUTS

The gross compositions of each of the thirteen raw, NHF approved beef cuts (excluding lean beef mince) were determined, so that the relative proportion of the raw lean meat, to the raw fat could be calculated. Table 4.1 provides the mean gross composition values for each of the thirteen beef cuts and the relative percentage proportion of raw lean meat, to raw fat, determined from these data.

Table 4.1 indicates that the percentage contribution of the lean meat to the gross composition of the NHF approved beef cuts ranged from 88 percent (sirloin steak), to 95 percent (silverside steak, silverside roast, topside steak, and topside cubes). Further, the relative proportion of the lean meat to fat ranged from 93:7 (sirloin steak) to 99:1 (silverside steak, and topside cubes).

**Table 4.1: The Gross Compositions of the Raw, NHF Approved Beef Cuts**

| NHF Approved Beef Cut | Mean Weight (g) | Lean (%) | Fat (%) | Gristle (%) | Dissection Loss (%) | Relative Proportions Lean (%) | Relative Proportions Fat (%) |
|---|---|---|---|---|---|---|---|
| Eye fillet steak | 270 | 91 | 5 | 3 | 1 | 95 | 5 |
| Eye fillet roast | 500 | 92 | 4 | 3 | 2 | 96 | 4 |
| Rump steak | 240 | 91 | 4 | 3 | 2 | 96 | 4 |
| Silverside steak | 275 | 95 | 1 | 2 | 1 | 99 | 1 |
| Silverside roast | 955 | 95 | 2 | 2 | 2 | 98 | 2 |
| Skirt steak | 310 | 93 | 3 | 3 | 1 | 97 | 3 |
| Blade steak, boneless | 255 | 94 | 2 | 4 | 1 | 98 | 2 |
| Round steak | 265 | 92 | 4 | 3 | 1 | 96 | 4 |
| Sirloin steak | 240 | 88 | 7 | 4 | 1 | 93 | 7 |
| Topside steak | 280 | 95 | 2 | 2 | 1 | 98 | 2 |
| Topside roast | 1140 | 94 | 3 | 2 | 2 | 97 | 3 |
| Topside strips | 305 | 94 | 2 | 2 | 3 | 98 | 2 |
| Topside cubes | 300 | 95 | 1 | 1 | 3 | 99 | 1 |

(Buick, D., 1993, Unpublished Report - Appendix 5)

## 4.2 THE NUTRIENT COMPOSITIONS OF THE FOURTEEN RAW, NHF APPROVED BEEF CUTS

Table 4.2 provides the nutrient compositions (twenty four nutrients) of the fourteen raw, NHF approved beef cuts. The fat content of these beef cuts ranged from 3.1g per 100 grams (silverside steak) to 10.9g per 100 grams (sirloin steak), while the cholesterol content ranged from 49mg per 100 grams (topside cubes) to 69mg per 100 grams (eye fillet steak, rump steak). The energy content ranged from 493kJ per 100 grams (silverside steak) to 753kJ per 100 grams (sirloin steak).

**Table 4.2: The Nutrient Compositions of the Raw, NHF Approved Beef Cuts (per 100g edible portion)**

| Raw NHF Approved Beef Cut | Water (g) | Protein (g) | Fat (g) | Ash (g) | Energy (kJ) | Cholesterol (mg) | Sodium (mg) | Potassium (mg) | Calcium (mg) | Iron (mg) | Magnesium (mg) | Zinc (mg) | Phosphorus (mg) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Eye fillet steak | 72.4 | 20.7 | 7.5 | 1.1 | 631 | 69 | 49 | 360 | 4 | 3.3 | 20 | 3.2 | 205 |
| Eye fillet roast | 72.8 | 20.9 | 6.9 | 1.1 | 612 | 68 | 49 | 360 | 4 | 3.4 | 20 | 3.2 | 205 |
| Rump steak | 70.2 | 22.5 | 6.0 | 1.0 | 606 | 69 | 48 | 365 | 6 | 2.7 | 19 | 3.9 | 205 |
| Silverside roast | 73.8 | 22.0 | 3.3 | 1.0 | 500 | 68 | 48 | 365 | 4 | 2.5 | 20 | 3.3 | 200 |
| Silverside steak | 74.0 | 22.1 | 3.1 | 1.0 | 493 | 67 | 48 | 365 | 4 | 2.5 | 20 | 3.3 | 200 |
| Skirt steak | 73.3 | 22.1 | 4.1 | 1.0 | 528 | 68 | 64 | 335 | 5 | 1.8 | 21 | 5.3 | 200 |
| Blade steak | 72.8 | 21.0 | 5.9 | 1.0 | 579 | 52 | 63 | 350 | 10 | 2.0 | 20 | 4.1 | 190 |
| Round steak | 72.4 | 20.4 | 6.5 | 1.0 | 592 | 59 | 65 | 320 | 3 | 1.4 | 24 | 4.0 | 195 |
| Sirloin steak | 67.6 | 20.4 | 10.9 | 1.0 | 753 | 52 | 59 | 350 | 18 | 1.7 | 20 | 3.2 | 200 |
| Topside steak | 72.7 | 21.3 | 4.6 | 1.0 | 533 | 50 | 53 | 345 | 3 | 1.9 | 27 | 2.9 | 210 |
| Topside roast | 72.6 | 21.3 | 4.7 | 1.0 | 538 | 50 | 53 | 345 | 3 | 1.9 | 26 | 2.9 | 210 |
| Topside strips | 73.0 | 21.4 | 4.2 | 1.0 | 519 | 50 | 53 | 345 | 3 | 1.9 | 27 | 3.0 | 210 |
| Topside cubes | 73.3 | 21.4 | 3.9 | 1.0 | 511 | 49 | 53 | 350 | 3 | 1.9 | 27 | 3.0 | 210 |
| Lean beef mince | 71.6 | 20.3 | 6.9 | 1.0 | 600 | 51 | 63 | 360 | 5 | 2.3 | 20 | 4.3 | 200 |

| Raw NHF Approved Beef Cut | Thiamin (mg) | Riboflavin (mg) | Niacin (mg) | Niacin eq (mg) | Retinol (ug) | B-Carotene eq (ug) | Retinol eq (ug) | Vitamin C (mg) | Fatty Acid Profile Total Sat. (g) | Total Mono. (g) | Total Poly. (g) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Eye fillet steak | 0.13 | 0.23 | 4.1 | 7.6 | 0 | 0 | 0 | 1 | 3.3 | 3.3 | 0.3 |
| Eye fillet roast | 0.13 | 0.23 | 4.2 | 7.7 | 0 | 0 | 0 | 1 | 3.0 | 3.0 | 0.3 |
| Rump steak | 0.10 | 0.25 | 4.7 | 8.5 | 0 | 0 | 1 | 1 | 2.7 | 2.7 | 0.2 |
| Silverside roast | 0.08 | 0.23 | 2.6 | 6.3 | 1 | 0 | 1 | 1 | 1.4 | 1.4 | 0.1 |
| Silverside steak | 0.08 | 0.23 | 2.6 | 6.3 | 1 | 0 | 1 | 1 | 1.3 | 1.3 | 0.1 |
| Skirt steak | 0.05 | 0.24 | 4.1 | 7.8 | 1 | 0 | 1 | 1 | 1.8 | 1.8 | 0.2 |
| Blade steak | 0.07 | 0.16 | 4.1 | 7.6 | 1 | 0 | 1 | 1 | 2.5 | 2.5 | 0.4 |
| Round steak | 0.06 | 0.15 | 3.6 | 7.0 | 3 | 0 | 3 | 1 | 3.0 | 2.8 | 0.3 |
| Sirloin steak | 0.07 | 0.11 | 5.1 | 8.6 | 3 | 0 | 3 | 0 | 4.9 | 4.8 | 0.4 |
| Topside steak | 0.08 | 0.14 | 6.0 | 9.6 | 1 | 0 | 1 | 2 | 1.9 | 2.0 | 0.2 |
| Topside roast | 0.08 | 0.14 | 6.0 | 9.5 | 1 | 0 | 1 | 2 | 2.0 | 2.1 | 0.2 |
| Topside strips | 0.08 | 0.14 | 6.0 | 9.6 | 1 | 0 | 1 | 2 | 1.7 | 1.8 | 0.2 |
| Topside cubes | 0.08 | 0.14 | 6.1 | 9.6 | 1 | 0 | 1 | 2 | 1.6 | 1.7 | 0.2 |
| Lean beef mince | 0.03 | 0.06 | 3.7 | 7.0 | 0 | - | 0 | - | 3.1 | 2.3 | 0.2 |

(Lewis, J., 1993, Unpublished Report - Appendix 6).

## 4.3 A COMPARISON OF THE FAT CONTENT OF THE RAW, NHF APPROVED BEEF CUTS TO PREVIOUSLY STUDIED AUSTRALIAN AND USA BEEF CUTS

Table 4.3 indicates the fat contents of the NHF approved beef cuts, comparable untrimmed Australian beef cuts published in 1989 (Cashel, K. et al., 1989) and similar U.S.A., trimmed (*select*) beef cuts, published in 1990 (Anderson, B.A. and Hoke, I.M., 1990).

**Table 4.3: The Fat Content of the Raw, NHF Approved Beef Cuts, Previous Australian Beef Cuts and U.S.A. Beef Cuts**

| Australia 1993 | | Australia 1989 | | USA 1990 | |
|---|---|---|---|---|---|
| NHF Approved Beef Cut | gFat/ 100g | Untrimmed Beef Cut | gFat/ 100g | Trimmed Beef Cut | gFat/ 100g |
| Eye fillet steak | 7.5 | Fillet | 10.7 | Tenderloin | 22.41 |
| Eye fillet roast | 6.9 | Fillet | 10.7 | Tenderloin | 22.41 |
| Rump steak | 6.0 | Rump | 16.7 | Top sirloin | 13.78 |
| Silverside roast | 3.3 | Silverside | 11.7 | Bottom round | 11.98 |
| Silverside steak | 3.1 | Silverside | 11.7 | Bottom round | 11.98 |
| Skirt steak | 4.1 | Skirt | 3.7 | Flank | 10.62 |
| Blade steak | 5.9 | Blade | 10.8 | Blade roast | 17.93 |
| Round steak | 6.5 | Round | 9.1 | Round, full cut | 11.59 |
| Sirloin steak | 10.9 | Sirloin | 17.2 | Top sirloin | 13.78 |
| Topside steak | 4.6 | Topside roast | 6.7 | Top round | 7.97 |
| Topside roast | 4.7 | Topside roast | 6.7 | Top round | 7.97 |
| Topside strips | 4.2 | Topside roast | 6.7 | Top round | 7.97 |
| Topside cubes | 3.9 | Topside roast | 6.7 | Top round | 7.97 |
| Lean beef mince | 6.9 | Beef mince, regular | 10.8 | Ground beef, extra lean | 17.06 |

(Cashel, K. et al., 1989; Anderson, B.A. and Hoke, I.M., 1990)

**Figure 4.1: A Comparison of the Fat Content of the Raw, NHF Approved Beef Cuts, with the Australian Beef Cuts Published in 1989.**

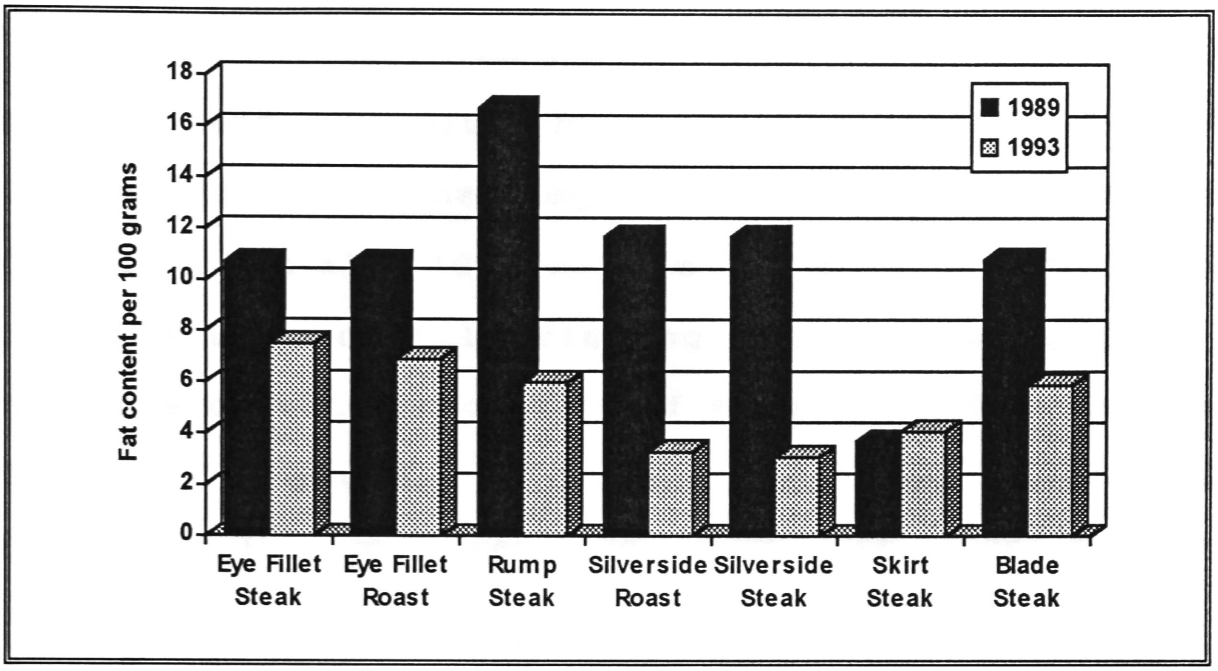
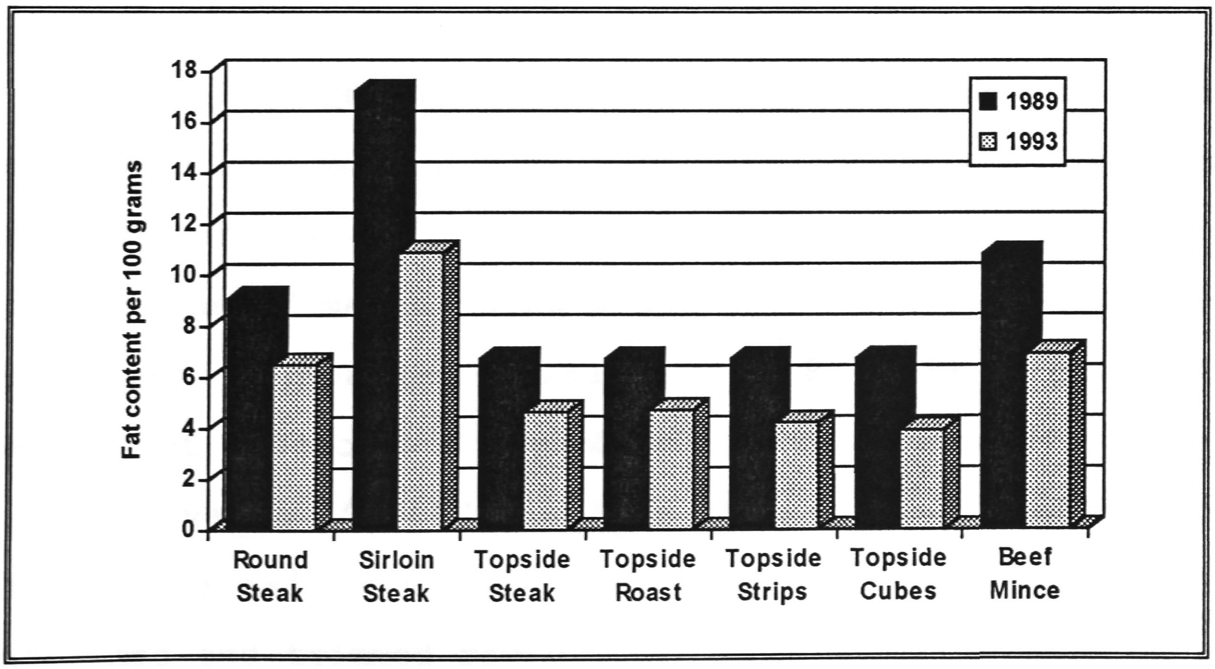



**Figure 4.1 Continued: A Comparison of the Fat Content of the Raw, NHF Approved Beef Cuts, with the Australian Beef Cuts Published in 1989.**



### 4.3.1 A COMPARISON WITH PREVIOUSLY STUDIED AUSTRALIAN BEEF CUTS

Figure 4.1 compares the fat content of the raw NHF approved beef cuts with those comparable untrimmed beef cuts published in the *Composition of Foods, Australia* (Cashel, K. et al., 1989). This bar graph and Table 4.3 indicate that retail trimming has had the greatest influence on the fat content of rump steak (decrease of 10.7g per 100 grams). In contrast the trimmed skirt steak analysed in 1993 contained 0.4g per 100 grams more fat than the untrimmed skirt steak studied in 1987. Figure 4.1 indicates that all of the raw, trimmed beef cuts, except skirt steak, contained less fat than the range of raw, untrimmed beef cuts studied in 1987 (Greenfield, H. et al., 1987 and Hutchison, G.I. et al., 1987a, and published in Cashel, K. et al., 1989).

Table 4.4 reveals that the mean fat content of the comparable raw beef cuts was: 10.0 (± 3.8) g per 100 grams in 1989 and 5.6 (± 2.1) g per 100 grams in 1993. Comparisons of means using a one tailed, unpaired t-test produced an unpaired t-value of 3.8, with twenty six degrees of freedom and a probability (p) value of 0.0004. As the p value (0.0004) is less than 0.01, a significant difference exists between the mean fat contents of the untrimmed and trimmed raw comparable Australian beef cuts, studied in 1987 and 1993.

Excepting skirt steak, the energy contents of the raw, NHF approved beef cuts studied in 1993 were also lower (66kJ per 100 grams to 352kJ per 100 grams) than those untrimmed beef cuts studied in 1987.

The cholesterol contents of the 1993 NHF approved beef cuts were zero to twelve mg per 100 grams less than the untrimmed beef cuts studied in 1987 (Cashel, K. et al., 1989). Appendix 7 provides the comparative data.

**Table 4.4: An Unpaired t-test on the Mean Fat Content of Currently and Previously Studied Australian Raw Beef Cuts**

Unpaired t-Test $X_1$ : year $Y_1$ : fat content

| DF: | Unpaired t Value: | Prob. (1-tail): |
|---|---|---|
| 26 | 3.8 | .0004 |

| Group: | Count: | Mean: | Std. Dev.: | Std. Error: |
|---|---|---|---|---|
| yr.89 | 14 | 10.0 | 3.8 | 1.0 |
| yr.93 | 14 | 5.6 | 2.1 | 0.60 |

**Figure 4.2: A Comparison of the Fat Content of the Raw, NHF Approved Beef Cuts with the Raw, U.S.A Beef Cuts Published in 1990.**

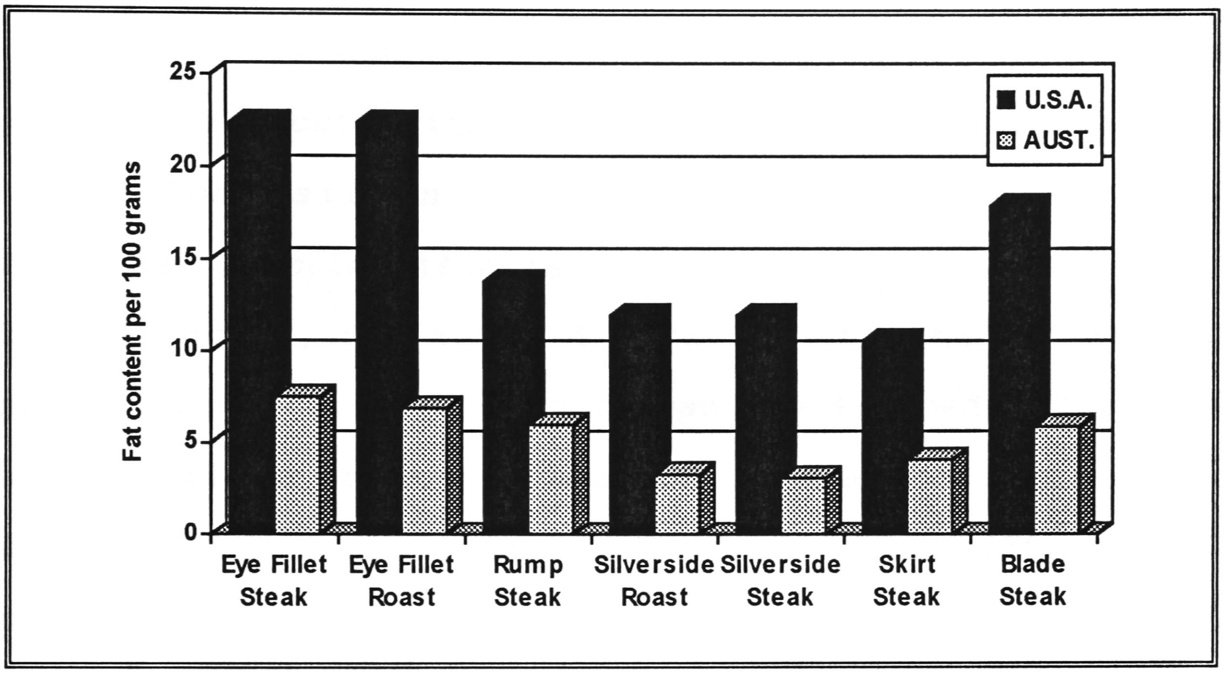
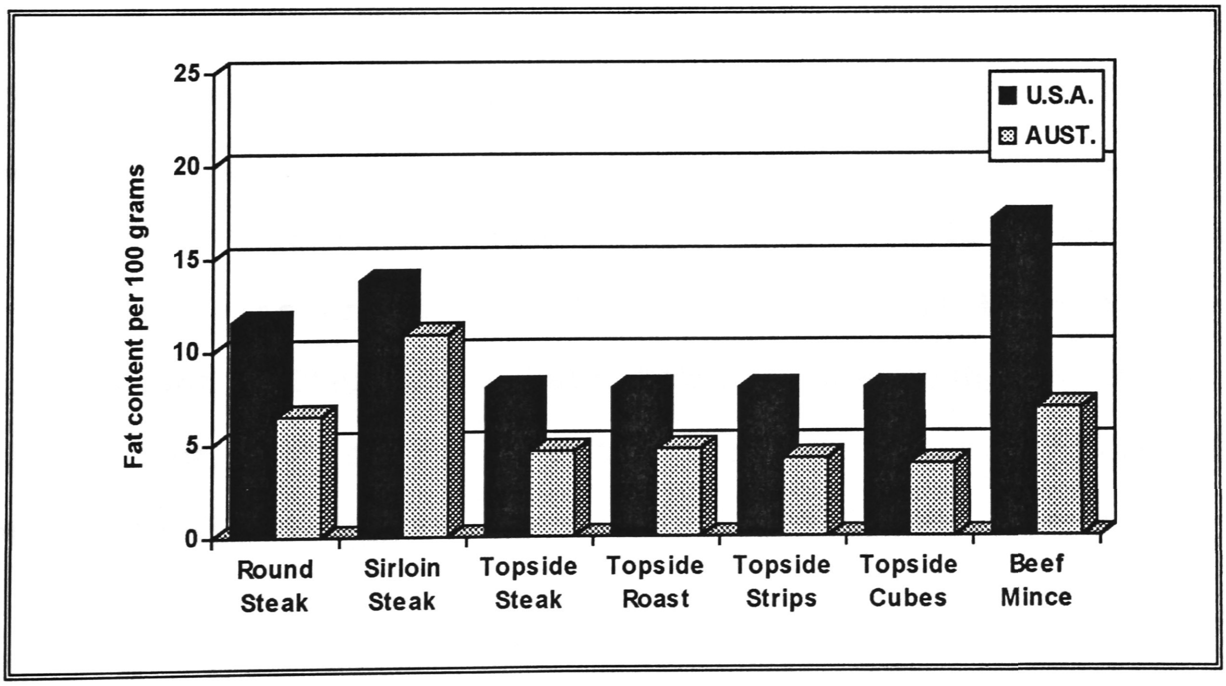



**Figure 4.2 Continued: A Comparison of the Fat Content of the Raw, NHF Approved Beef Cuts with the Raw, USA Beef Cuts Published in 1990.**



## 4.3.2 <u>A COMPARISON WITH PREVIOUSLY STUDIED U.S.A. BEEF CUTS</u>

Figure 4.2 compares the fat content of the raw, NHF approved beef cuts with those similar beef cuts published in the *Composition of Foods: Beef Products. Raw, Processed, Prepared* (Anderson, B.A. and Hoke, I.M., 1990). This bar graph, and Table 4.3 reveal that all of the NHF approved beef cuts are leaner than the trimmed U.S.A. beef cuts. Sirloin steak had the most comparable fat content between the two countries (a difference of 2.88g per 100 grams), while eye fillet roast had the larger difference in fat content, between the two countries (a difference of 15.51 grams).

Table 4.5 reveals that the mean fat content of the NHF approved beef cuts was 5.6 (± 2.1) g per 100 grams, while the mean fat content of the trimmed U.S.A. beef cuts was 13.2 (± 5.0) g per 100 grams. Application of a one tailed, unpaired t-test produced an unpaired t-value of 5.2, with twenty six degrees of freedom, and a probability (p) value of 0.0001. As the p value (0.0001) is less than 0.01, a significant difference exists between the mean fat content of the raw, NHF approved beef cuts and those similar raw beef cuts published in the U.S.A. in 1990.

**Table 4.5: An Unpaired t-test on the Mean Fat Content of the Currently Studied Raw Australian Beef Cuts, and Previously Studied Raw U.S.A. Beef Cuts**

Unpaired t-Test $X_1$ : Country $Y_1$ : fat content

| DF: | Unpaired t Value: | Prob. (1-tail): |
|---|---|---|
| 26 | 5.2 | .0001 |

| Group: | Count: | Mean: | Std. Dev.: | Std. Error: |
|---|---|---|---|---|
| U.S.A | 14 | 13.2 | 5.0 | 1.3 |
| AUST. | 14 | 5.6 | 2.1 | 0.60 |

## 4.4 THE GROSS COMPOSITIONS OF THE THIRTEEN COOKED, NHF APPROVED BEEF CUTS

Table 4.6 indicates the cooked reference cut, and cooking method used to calculate the gross compositions of the thirteen cooked NHF approved beef cuts. The percentages of the lean meat, and the fat components lost on cooking are provided, as are the derived relative proportions of cooked lean meat, and fat for each beef cut.

It is evident that the loss of lean meat by cooking would be similar between different beef cuts and cooking methods. However, the proportion of lean meat lost would be slightly higher when the beef cuts were stewed, and lower when they were grilled, roasted or stir fried.

In contrast, the loss of percentage fat would vary greatly, depending on the beef cut and the cooking method applied. The computed loss of percentage fat reveals that grilling causes the highest loss of fat, followed by roasting and stir frying. The results in Table 4.6 suggest that stewing would cause a negative loss of fat, and thus a fat gain, when the beef cuts are cooked in that manner.

Although the beef cuts would lose varying amounts of lean meat and fat on cooking, due to their cut type and cooking method, it is evident that all of the beef cuts had derived cooked lean meat proportions above 91 percent. Table 4.6 reveals that the percentage proportion of the lean meat to fat derived after cooking, ranged from 92:8 (round steak) to 99:1 (silverside steak, silverside roast and blade steak). Further, the largest difference between the relative percentage proportion of lean meat to fat after cooking, as compared to the raw meat was four percent (96:4 round steak, raw and 92:8 after cooking).

**Table 4.6: The Derivation of the Relative Proportion of Cooked Lean Meat and Fat**

| NHF Approved Beef Cut | Cooked Reference Cut from The Australian Food Composition Tables 1989 | Cooking Method Applied to Raw Cut | Cooking Loss of Reference Cut by Listed Cooking Method | | Derived Relative Proportion Cooked Lean & Fat | |
|---|---|---|---|---|---|---|
| | | | Loss of Lean % | Loss of Fat % | Lean (%) | Fat (%) |
| Eye fillet steak | Fillet steak | grilled | 29 | 51 | 96 | 4 |
| Eye fillet roast | Silverside roast | roasted | 27 | 44 | 97 | 3 |
| Rump steak | Rump steak | grilled | 23 | 56 | 97 | 3 |
| Silverside steak | Fillet steak | grilled | 29 | 51 | 99 | 1 |
| Silverside roast | Silverside roast | roasted | 27 | 44 | 99 | 1 |
| Skirt steak | Skirt steak | stewed | 35 | -18 | 95 | 5 |
| Blade steak | Blade steak | grilled | 25 | 34 | 99 | 1 |
| Round steak | Skirt steak | stewed | 35 | -18 | 92 | 8 |
| Sirloin steak | Sirloin steak | grilled | 27 | 49 | 95 | 5 |
| Topside steak | Skirt steak | stewed | 35 | -18 | 96 | 4 |
| Topside roast | Silverside roast | roasted | 27 | 44 | 98 | 2 |
| Topside strips | Lamb, stir fry | stir fried | 23 | 11 | 98 | 2 |
| Topside cubes | Skirt steak | stewed | 35 | -18 | 98 | 2 |

(Lewis, J., 1993, Unpublished Report - Appendix 6)

## 4.5 THE NUTRIENT COMPOSITIONS OF THE FOURTEEN COOKED, NHF APPROVED BEEF CUTS

Table 4.7 provides the derived nutrient compositions (twenty four nutrients) of the fourteen cooked, NHF approved beef cuts. The fat content of the cooked beef cuts ranged from 5.4g per 100 grams (silverside steak, grilled and silverside roast, roasted) to 11.7g per 100 grams (sirloin steak, grilled), while the cholesterol content ranged from 65mg per 100 grams (blade steak, grilled) to 83mg per 100 grams (eye fillet steak, grilled; eye fillet roast, roasted; rump steak, grilled; and skirt steak, stewed). The energy content ranged from 676kJ per 100 grams (topside strips, stir fried) to 904kJ per 100 grams (sirloin steak, grilled).

**Table 4.7: The Nutrient Compositions of the Cooked, NHF Approved Beef Cuts (per 100g edible portion)**

| Cooked NHF Approved Beef Cut | Moisture (g) | Protein (g) | Fat (g) | Ash (g) | Energy (kJ) | Cholesterol (mg) | Sodium (mg) | Potassium (mg) | Calcium (mg) | Iron (mg) | Magnesium (mg) | Zinc (mg) | Phosphorus (mg) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Eye fillet steak | 60.8 | 29.5 | 10.2 | 1.3 | 880 | 83 | 59 | 375 | 6 | 4.0 | 22 | 4.3 | 250 |
| Eye fillet roast | 60.9 | 29.6 | 10.0 | 1.3 | 875 | 83 | 59 | 375 | 6 | 4.0 | 22 | 4.4 | 250 |
| Rump steak | 59.9 | 32.1 | 8.5 | 1.1 | 861 | 83 | 54 | 355 | 5 | 3.8 | 18 | 5.0 | 250 |
| Silverside roast | 60.6 | 33.5 | 5.4 | 1.1 | 772 | 82 | 50 | 330 | 5 | 3.8 | 23 | 5.4 | 235 |
| Silverside steak | 60.6 | 33.5 | 5.4 | 1.1 | 770 | 82 | 50 | 330 | 5 | 3.8 | 23 | 5.4 | 235 |
| Skirt steak | 58.0 | 34.4 | 7.8 | 1.0 | 878 | 83 | 64 | 265 | 5 | 2.7 | 20 | 10.0 | 230 |
| Blade steak | 63.8 | 28.4 | 7.6 | 1.1 | 767 | 65 | 73 | 365 | 13 | 2.5 | 23 | 5.8 | 220 |
| Round steak | 60.2 | 28.7 | 10.5 | 1.1 | 878 | 74 | 61 | 345 | 5 | 2.0 | 30 | 5.4 | 230 |
| Sirloin steak | 58.4 | 27.7 | 11.7 | 1.0 | 904 | 68 | 73 | 370 | 25 | 2.8 | 25 | 4.6 | 245 |
| Topside steak | 64.0 | 25.8 | 7.7 | 1.0 | 726 | 67 | 55 | 330 | 4 | 2.3 | 25 | 3.8 | 225 |
| Topside roast | 65.0 | 26.2 | 6.2 | 1.0 | 677 | 66 | 56 | 335 | 4 | 2.4 | 26 | 3.9 | 230 |
| Topside strips | 65.0 | 26.2 | 6.2 | 1.0 | 676 | 66 | 56 | 335 | 4 | 2.4 | 26 | 3.9 | 230 |
| Topside cubes | 64.8 | 26.1 | 6.4 | 1.0 | 684 | 66 | 56 | 335 | 4 | 2.4 | 25 | 3.9 | 230 |
| Lean beef mince | 64.4 | 25.8 | 7.9 | 1.3 | 731 | 68 | 85 | 470 | 6 | 3.0 | 25 | 5.2 | 250 |

| Cooked NHF Approved Beef Cut | Thiamin (mg) | Riboflavin (mg) | Niacin (mg) | Niacin eq (mg) | Retinol (ug) | B-Carotene eq (ug) | Retinol eq (ug) | Vitamin C (mg) | Fatty Acid Profile Total Sat. (g) | Total Mono. (g) | Total Poly. (g) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Eye fillet steak | 0.13 | 0.32 | 5.8 | 10.8 | 0 | 0 | 0 | 0 | 4.6 | 4.3 | 0.3 |
| Eye fillet roast | 0.13 | 0.32 | 5.9 | 10.8 | 0 | 0 | 0 | 0 | 4.5 | 4.3 | 0.3 |
| Rump steak | 0.10 | 0.36 | 6.5 | 11.8 | 1 | 0 | 1 | 0 | 3.8 | 3.6 | 0.3 |
| Silverside roast | 0.90 | 0.37 | 4.1 | 9.7 | 1 | 0 | 1 | 0 | 2.4 | 2.3 | 0.2 |
| Silverside steak | 0.90 | 0.37 | 4.1 | 9.7 | 1 | 0 | 1 | 0 | 2.4 | 2.3 | 0.2 |
| Skirt steak | 0.40 | 0.38 | 6.4 | 12.2 | 1 | 0 | 1 | 0 | 3.6 | 3.4 | 0.2 |
| Blade steak | 0.11 | 0.21 | 4.2 | 8.9 | 0 | 0 | 0 | 0 | 3.3 | 3.3 | 0.3 |
| Round steak | 0.80 | 0.15 | 3.9 | 8.7 | 2 | 0 | 2 | 0 | 4.6 | 4.3 | 0.3 |
| Sirloin steak | 0.10 | 0.14 | 5.9 | 10.5 | 2 | 0 | 2 | 0 | 5.5 | 4.8 | 0.4 |
| Topside steak | 0.11 | 0.16 | 5.8 | 10.1 | 2 | 0 | 2 | 0 | 3.3 | 3.6 | 0.3 |
| Topside roast | 0.11 | 0.16 | 5.9 | 10.3 | 1 | 0 | 1 | 0 | 2.6 | 2.8 | 0.3 |
| Topside strips | 0.11 | 0.16 | 5.9 | 10.3 | 1 | 0 | 1 | 0 | 2.6 | 2.8 | 0.3 |
| Topside cubes | 0.11 | 0.16 | 5.9 | 10.3 | 1 | 0 | 1 | 0 | 2.7 | 2.9 | 0.3 |
| Lean beef mince | 0.50 | 0.05 | 4.5 | 8.8 | 8 | - | 8 | - | 3.5 | 3.4 | 0.3 |

(Lewis, J., 1993, Unpublished Report - Appendix 6).

## 4.6 A COMPARISON OF THE FAT CONTENT OF THE COOKED, NHF APPROVED BEEF CUTS TO PREVIOUSLY STUDIED AUSTRALIAN, AND U.S.A. BEEF CUTS

Table 4.8 presents the fat content of the NHF approved cooked beef cuts, the comparable untrimmed Australian beef cuts published in 1989 (Cashel, K. et al., 1989) and similar U.S.A., trimmed (*select*) beef cuts, published in 1990 (Anderson, B.A. and Hoke, I.M., 1990).

**Table 4.8: The Fat Content of the Cooked, NHF Approved Beef Cuts, Previous Australian Beef Cuts and U.S.A. Beef Cuts**

| Australia 1993 | | Australia 1989 | | USA 1990 | |
|---|---|---|---|---|---|
| NHF Approved Beef Cut | gFat/ 100g | Untrimmed Beef Cut | gFat/ 100g | Trimmed Beef Cut | gFat/ 100g |
| Eye fillet steak | 10.2 | Fillet steak, grilled | 13.2 | Tenderloin grilled | 17.94 |
| Eye fillet roast | 10.0 | Fillet steak, grilled | 13.2 | Tenderloin grilled | 17.94 |
| Rump steak | 8.5 | Rump steak, grilled | 16.8 | Top sirloin grilled | 13.90 |
| Silverside roast | 5.4 | Silverside roast, roasted | 11.7 | Bottom round roasted | 13.24 |
| Silverside steak | 5.4 | Silverside roast, roasted | 11.7 | Bottom round roasted | 13.24 |
| Skirt steak | 7.8 | Skirt steak, stewed | 6.2 | Flank, braised | 16.44 |
| Blade steak | 7.6 | Blade steak, grilled | 10.6 | Blade steak, braised | 23.35 |
| Round steak | 10.5 | Round steak, grilled | 9.6 | Round, full cut, grilled | 11.73 |
| Sirloin steak | 11.7 | Sirloin steak, grilled | 19.1 | Top sirloin braised | 13.90 |
| Topside steak | 7.7 | Topside roast, roasted | 10.0 | Top round, braised | 9.86 |
| Topside roast | 6.2 | Topside roast, roasted | 10.0 | Top round, grilled | 8.51 |
| Topside strips | 6.2 | Topside roast, roasted | 10.0 | Top round, braised | 9.86 |
| Topside cubes | 6.4 | Topside roast roasted | 10.0 | Top round braised | 9.86 |
| Lean beef mince | 7.9 | Beef mince, simmered and drained | 9.8 | Ground beef, extra, lean, pan fried, medium | 16.42 |

(Cashel, K. 1989; Anderson, B.A. and Hoke, I.M., 1990)

### 4.6.1 A COMPARISON WITH PREVIOUSLY STUDIED AUSTRALIAN BEEF CUTS

Figure 4.3 compares the fat content of the cooked, NHF approved beef cuts with those comparable beef cuts published in the *Composition of Foods, Australia* (Cashel, K. et al., 1989). This bar graph and Table 4.8 indicate that retail trimming has had the greatest influence on the fat content of rump steak. (A decrease of 8.3g per 100 grams). In contrast the cooked trimmed skirt steak and round steak had higher fat contents than the untrimmed beef cuts studied in 1987. (An increase of 1.6g per 100 grams, and 0.9g per 100 grams respectively).

Table 4.9 indicates that the mean fat content of the comparable cooked cuts was: 11.6 (± 3.2) g per 100 grams in 1989 and 8.0 (±2.0) g per 100 grams in 1993. A one tailed, unpaired t-test produced an unpaired t value of 3.5, with twenty-six degrees of freedom and a probability (p) value of 0.0007. As the p value (0.0007) is less than 0.01, a significant difference exists between the mean fat contents of the comparable cooked beef cuts studied in 1987 and 1993.

Excepting skirt steak and round steak, the energy contents of the NHF approved beef cuts studied in 1993 were also lower (33kJ per 100 grams to 269kJ per 100 grams) than those untrimmed beef cuts studied in 1987. Except for round steak, the cholesterol contents of the 1993 NHF

**Figure 4.3: A Comparison of the Fat Content of the Cooked, NHF Approved Beef Cuts, with the Australian Beef Cuts Published in 1989**

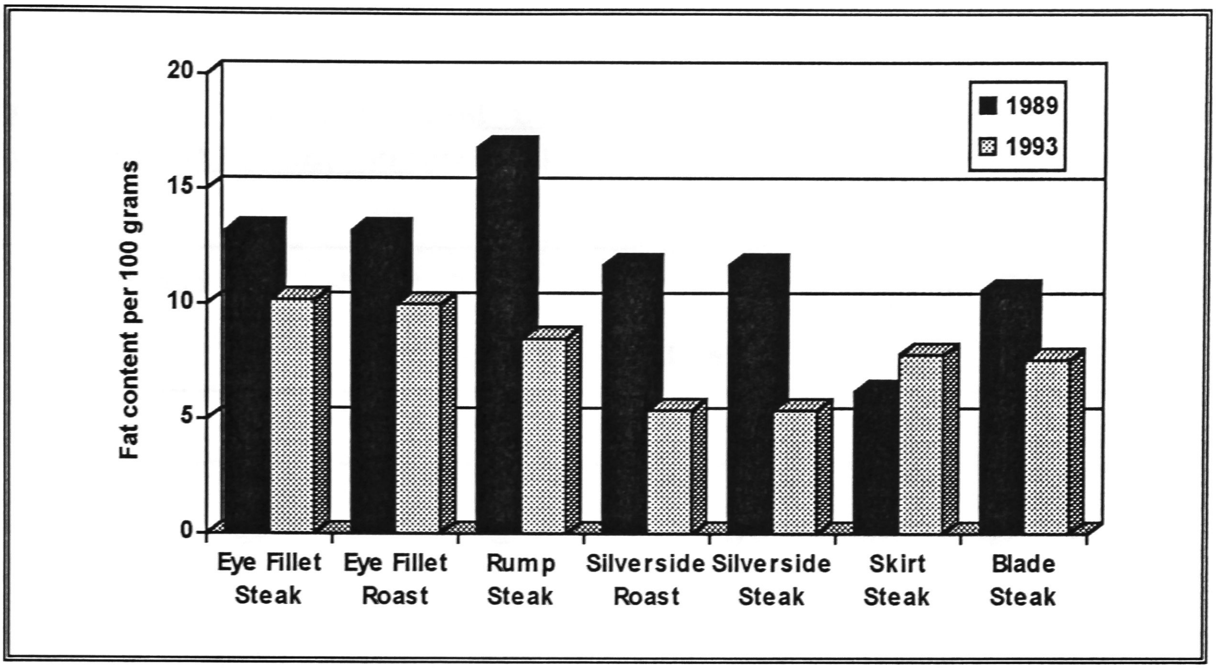
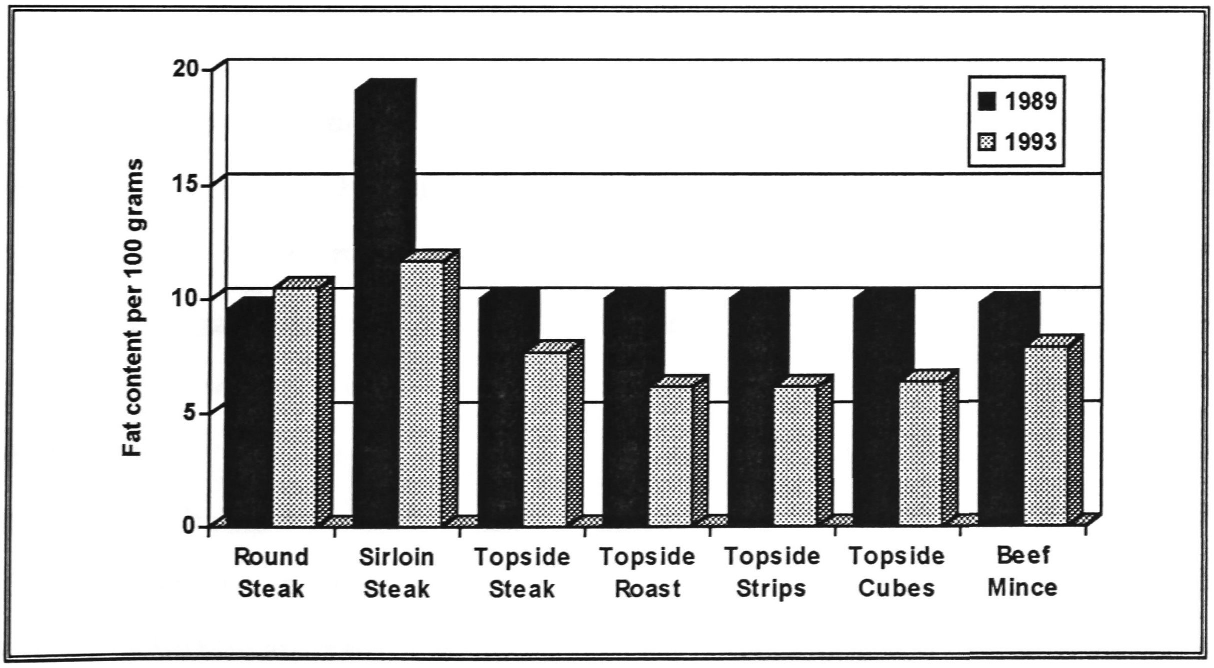



**Figure 4.3 Continued: A Comparison of the Fat Content of the Cooked, NHF Approved Beef Cuts, with the Australian Beef Cuts Published in 1989**



approved beef cuts were zero to five mg per 100 grams less than the untrimmed beef cuts studied in 1987 (Cashel, K. et al., 1989). Appendix 7 provides the comparative data.

**Table 4.9: An Unpaired t-test on the Mean Fat Content of the Currently and Previously Studied Cooked Australian Beef Cuts**

Unpaired t-Test $X_1$ : year $Y_1$ : fat content

| DF: | Unpaired t Value: | Prob. (1-tail): |
|---|---|---|
| 26 | 3.5 | .0007 |

| Group: | Count: | Mean: | Std. Dev.: | Std. Error: |
|---|---|---|---|---|
| yr 89 | 14 | 11.6 | 3.2 | 0.90 |
| yr 93 | 14 | 8.0 | 2.0 | 0.53 |

### 4.6.2 A COMPARISON WITH PREVIOUSLY STUDIED U.S.A. BEEF CUTS

Figure 4.4 compares the fat content of the NHF approved cooked beef cuts with those similar cuts published in the *Composition of Foods: Beef Products. Raw, Processed, Prepared* (Anderson, B.A. and Hoke, I.M., 1990). This bar graph and Table 4.8 reveal that all of the NHF approved cooked beef cuts are leaner than the cooked U.S.A. beef cuts. Round steak had the most comparable fat content between the two countries (A difference of 1.23g per 100 grams), while blade steak had the largest difference in fat content between the two countries (difference of 15.75g per 100 grams).

**Figure 4.4: A Comparison of the Fat Content of the Cooked, NHF Approved Beef Cuts with the Cooked, U.S.A. Beef Cuts Published in 1990**

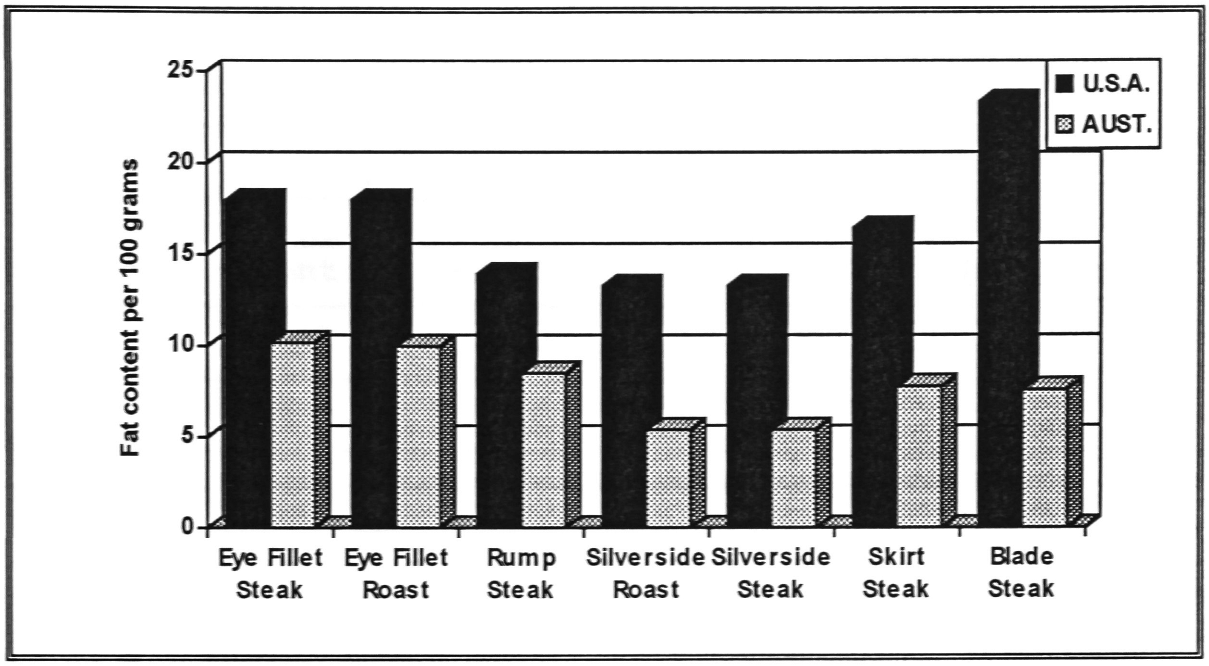



**Figure 4.4 Continued: A Comparison of the Fat Content of the Cooked, NHF Approved Beef Cuts with the Cooked, U.S.A. Beef Cuts Published in 1990**

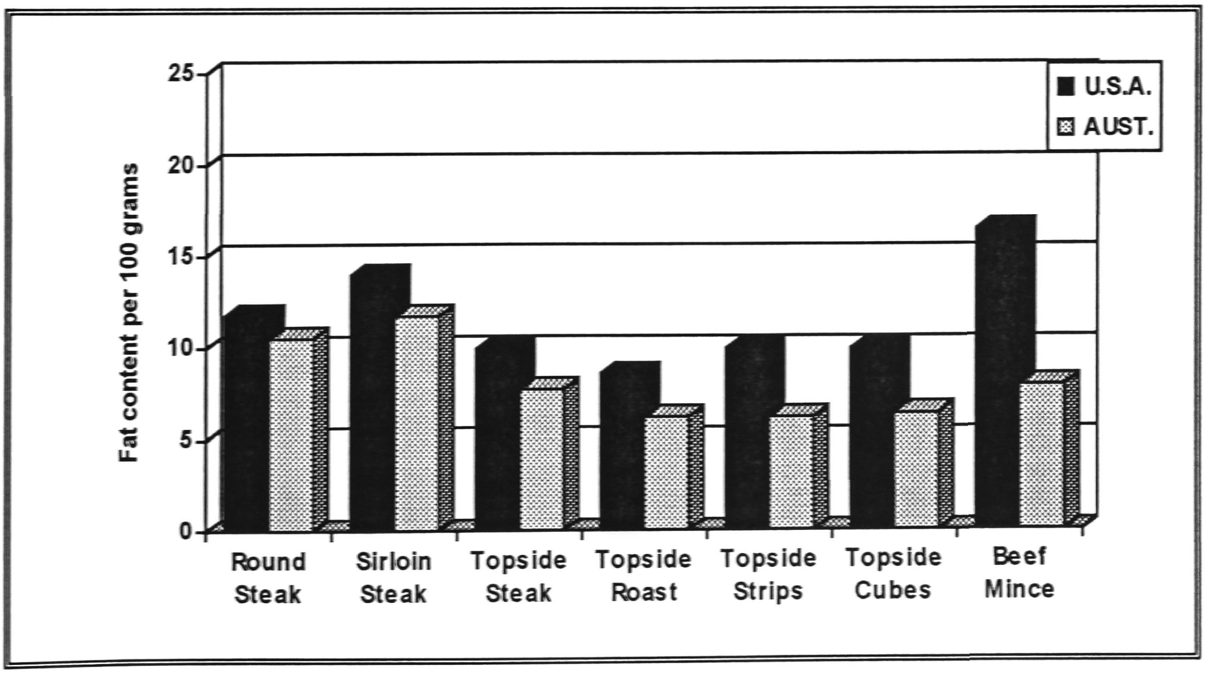


**Table 4.10: An Unpaired t-test on the Mean Fat Content of the Currently Studied Cooked Australian Beef Cuts, and Previously Studied Cooked U.S.A. Beef Cuts**

Unpaired t-Test $X_1$ : Country $Y_1$ : fat content

| DF: | Unpaired t Value: | Prob. (1-tail): |
|---|---|---|
| 26 | 5.0 | .0001 |

| Group: | Count: | Mean: | Std. Dev.: | Std. Error: |
|---|---|---|---|---|
| U.S.A. | 14 | 14.0 | 4.1 | 1.1 |
| AUST. | 14 | 8.0 | 2.0 | 0.53 |

Table 4.10 indicates that the mean content of fat per 100 grams for the NHF approved beef cuts is 8.0 (± 2.0), while the mean fat content per 100 grams of the trimmed U.S.A. beef cuts is 14.0 (± 4.1). A one tailed, unpaired t-test produced an unpaired t value of 5.0, with twenty six degrees of freedom and a probability (p) value of 0.0001. As the p value (0.0001) is less than 0.01, a significant difference exists between the fat content of the cooked NHF approved beef cuts and those similar cooked beef cuts published in the U.S.A. in 1990.

# CHAPTER FIVE

# DISCUSSION

## 5.0 DISCUSSION

In the 1990's, the relationships between diet and health are a source of concern for many Australian health professionals and consumers. Access to an accurate and up to date Australian nutrient composition dataset is essential if health professionals, policy makers and the media are to appropriately address these concerns, via nutrition education, health promotion and health policy.

Ongoing food composition programmes are necessary in order to provide Australians with accurate, and regularly revised nutrition information. The current study is one such programme which will provide new knowledge about the nutrient composition of lean beef, to the expanding national nutrient dataset.

This discussion will consider the findings of the current study within the context of the ongoing Australian nutrient composition programme. It will provide a new perspective on the value of an up to date Australian dataset, through discussion of comparative Australian and U.S.A. beef data. Further, this discussion will highlight the need for an accurate and up to date Australian nutrient dataset, and a number of its applications.

## 5.1 A COMPARISON OF THE NHF APPROVED BEEF CUTS ANALYSED IN 1993 AND THE UNTRIMMED COMPARABLE BEEF CUTS ANALYSED IN 1987

The current study, commissioned by the Australian Meat and Livestock Corporation, aimed to determine the nutrient compositions of the fourteen NHF approved beef cuts, in their raw and cooked forms. The results of this study indicated that this aim has been fulfilled. Therefore this new nutrient information can be made available to Australians.

A comparison of the nutrient compositions of these NHF approved beef cuts, with those untrimmed, comparable beef cuts (lean meat and fat data) studied in 1987 (Greenfield, H. et al., 1987, and Hutchison, G.I. et al., 1987a, and published in Cashel, K. et al., 1989) revealed the need for regular revisions of food composition data. It was particularly apparent that the introduction of new foods (e.g. fat trimmed) onto the Australian market require accompanying nutrient composition data, if their nutritional value is to be adequately portrayed.

A comparison of the two ranges of beef composition data was initiated to determine the effect that retail trimming has on the fat content of comparable beef cuts. The nutrient compositions of all of the raw and cooked NHF approved beef cuts compared more closely to the 'lean meat only' data in the 1989 *Composition of Foods, Australia* (Cashel, K. et al., 1989), than to the 'lean meat and fat' data. This was expected because the NHF approved beef cuts are comparable cuts but have all of the visible selvedge fat removed.

### 5.1.1 THE RAW BEEF CUTS

A comparison of the fat contents (per 100 grams) of the two ranges of comparable beef cuts in their raw state revealed that all of the NHF approved beef cuts, except skirt steak, were leaner than the untrimmed beef cuts studied in 1987 (Cashel, K. et al., 1989). The skirt steak was only four tenths of a gram per 100 grams, fatter in 1993 (4.1g per 100 grams), and had been extremely lean compared to the other cuts analysed in 1987 (Cashel, K. et al., 1989).

Composite samples were utilised to determine the fat content of the skirt steak analysed in 1987, from which the 1993 value was derived (Greenfield, H. et al., 1987). If replicate samples had been utilised, which were recommended by Watson, M.J. et al. (1992), a sample variation of at least four-tenths of a gram per 100 grams may have been indicated. However, the fat content of skirt steak is comparable to the other beef cuts analysed in 1993 which range from 3.1g per 100 grams (silverside steak) to 10.9g per 100 grams (sirloin steak). It also meets the criteria for NHF approval. Thus it is still considered a lean beef cut.

Excepting sirloin steak, all of the raw, NHF approved beef cuts had fat contents of less than ten percent. The sirloin steak, trimmed of all visible fat and analysed in 1987 had a fat content of 6.9g per 100 grams (Hutchison, G.I. et al., 1987a). The NHF approved sirloin steak analysed at the Australian Government Analytical Laboratories (N.S.W.) had also met the criteria for NHF approval (AMLC, Personal Communication, 1993). Thus it was expected that the raw, NHF approved sirloin steak studied in 1993, would have a fat content of less than ten percent.

Incorrect trimming practices at the retail level may have been associated with the higher than expected level of fat content. However, as NHF approved raw sirloin steak has been found to contain 10.9 percent fat, it should no longer be referred to as NHF approved, because it does not meet one of the criteria for NHF approval. These criteria stipulate a fat content of less than ten percent, and a sodium content of less than 120mg per 100 grams (National Heart Foundation of Australia, 1992).

This finding reveals the importance of accurate and up to date Australian nutrient data. Although the sirloin steak analysed (fat, cholesterol and sodium only) at the

Australian Government Analytical Laboratories (N.S.W.) in 1987, and the 'lean meat only' data for sirloin steak, published in the 1989 Food Tables both had fat contents of less than ten percent, the sirloin steak studied in 1993 did not. This discrepancy has revealed the need for accurate, representative and up to date nutrient composition data, if meaningful recommendations are to be based on such information.

In comparing the mean fat contents of the raw beef cuts analysed in 1987 and 1993, a significant difference is evident ($p<0.01$). The NHF approved beef cuts analysed in 1993 contain less fat and thus less energy and cholesterol, than the untrimmed, comparable beef cuts analysed in 1987. The amount of fat trimmed off the NHF approved beef cuts is comparable to the arbitrarily determined, seventy-five percent fat trimmed beef cuts published in 1989 (Cashel, K. et al., 1989).

### 5.1.2 THE COOKED BEEF CUTS

Greenfield, H. et al., (1987) reported that the cooking of beef causes it to lose moisture, but increase its fat, protein, energy and cholesterol content. Concentration, due to a loss of moisture was the suggested cause of these changes in nutrient content (Greenfield, H. et al., 1987). The nutrient compositions of the raw and cooked beef cuts investigated in the current study were derived from data which were based on the previous beef composition studies of Greenfield, H. et al., (1987) and Hutchison, G.I. et al., (1987a) (published in Cashel, K. et al., 1989). As would be expected, the derived nutrient compositions of the NHF approved beef cuts showed similar changes in nutrient content between the raw and cooked nutrient composition data.

Similarly to the raw data, comparisons of the mean fat contents of the cooked NHF approved beef cuts with the untrimmed, comparable cuts, revealed a significant difference ($p<0.01$). In considering the individual cuts, all of the cooked NHF approved beef cuts were leaner than the comparable, untrimmed beef cuts, except skirt steak and round steak.

The raw skirt steak was leaner when analysed in 1987, thus it was expected to also be higher in fat when cooked in 1993, than the cooked skirt steak analysed in 1987. The raw NHF approved round steak was leaner than the comparable cut in 1987, while the cooked round steak was leaner in 1987 than in 1993. These results can be explained as the round steak was grilled in 1987 (Hutchison, G.I. et al., 1987a) and stewed in 1993.

The derived nutrient compositions of the beef cuts in the current study were based on the data provided by the beef composition studies of Greenfield, H. et al. (1987)

and Hutchison, G.I. et al. (1987a) (published in Cashel, K. et al., 1989). These derivations indicate that beef cuts which are stewed lose less fat on cooking than those that are grilled. Thus it is evident that the difference in cooking methods probably lead to the differences in fat content. This finding reveals the importance of ensuring that the cooking method of the food is considered when comparing and assessing the nutrient compositions of foods.

In considering all of the cooked NHF approved beef cuts, it is evident that they are significantly leaner ($p<0.01$) and lower in energy, than the comparable cooked, untrimmed beef cuts analysed in 1987 (Greenfield, H. et al., 1987, and Hutchison, G.I. et al., 1987a). Further, the level of trimming in 1993 resembles closely the fat content of the arbitrarily determined seventy-five percent fat trimmed beef cuts, published in 1989 (Cashel, K. et al., 1989).

This comparison, and in particular the issues concerning sirloin steak, have indicated the need for comprehensive nutrient composition studies to closely follow the release of new food items. In the four years since the introduction of the *Composition of Foods, Australia* (Cashel, K. et al., 1989) some nutritionists have probably been using the 'lean meat only' figures, some would have used the 'lean meat and fat' figures, while some would have used the fat trimmed figures to estimate the compositions of the NHF approved beef cuts. Although the availability of comparable data are preferable to no data at all, it is evident that accurate, representative and up to date data are necessary if the most appropriate and meaningful nutrient information is to be provided.

The current study has allowed nutrient composition data to be derived for the NHF approved beef cuts, although it did not actually involve the nutrient analyses of these cuts (excepting beef mince). As complete nutritional analyses are costly, it was recommended in 1990 that gross composition data be used to derive future nutrient compositions of meats on a regular basis (Cashel, K., 1990). Although the current study used an acceptable methodology, the absence of complete nutritional analyses must still be considered a limitation of this study.

## 5.2 A COMPARISON OF THE NHF APPROVED BEEF CUTS WITH THE TRIMMED BEEF CUTS AVAILABLE IN THE U.S.A.

In recent years health conscious consumers in the U.S.A. have been demanding leaner red meats. Retailers have responded to these demands by providing a range of *select* (or alternatively called *good*) grade beef cuts (which are trimmed to one quarter of an inch external fat), in addition to the regularly available *prime* and *choice* grade beef cuts (Sweeten, M.K. et al., 1990). The nutrient composition of the *select* range of fat trimmed beef cuts has been studied and was published in 1990 (Anderson, B.A. and Hoke, I.M., 1990).

A comparison between the leanest range of beef in Australia and those available in the U.S.A. was conducted during the current study, so as to determine the effect of retail trimming and beef production methods on the fat content of the beef cuts produced. It was expected that the fat content of the trimmed beef cuts in the U.S.A. would be greater than the Australian trimmed beef cuts, due to the differing production and trimming methods in each country (Hosking, M. and Rogers, J, 1989). Thus the comparison was conducted to determine if all of the Australian NHF approved beef cuts were leaner and whether a significant difference existed between the mean fat content of the U.S.A. trimmed beef cuts, as compared to the mean fat content of the NHF approved, Australian beef cuts.

Significant differences in the mean fat contents were found between the two ranges of beef, for both raw and cooked beef cuts ($p<0.01$). Additionally, each individual NHF approved beef cut was leaner than its most comparable American cut, in both the raw and cooked state. These differences can be explained by the method of livestock production in the U.S.A., which favours fatter beef, and the amount of retail fat trimming that is performed.

The *National Beef Market Basket Survey* revealed that forty-two percent of beef cuts in the U.S.A. had no selvedge fat, and that the mean thickness of external fat for all retail beef cuts was 0.11 of an inch (Savell, J.W. et al., 1988). However, it is not evident that a range of beef cuts exist in the U.S.A. which are specifically trimmed of all visible fat. The most recent nutrient composition tables (Anderson, B.A. and Hoke, I.M., 1990) include trimmed *select* beef cuts as the leanest range of beef cuts. As these data are the most recent, the *select* beef cuts were the range of trimmed beef cuts used for the comparison of Australian and U.S.A. beef cuts in the current study.

Although some of the beef cuts and cooking methods utilised were not directly comparable, the difference between the mean fat contents of the selected Australian beef cuts and the most comparable U.S.A. beef cuts was significant ($p<0.01$). This indicated that the Australian NHF approved lean beef cuts (raw and cooked) are significantly leaner than the trimmed (*select*) beef cuts, available in the U.S.A. The exact amount of difference in fat content for each individual beef cut can not be determined conclusively, as the cuts are not from exactly the same location on the beef carcass and some of the cooked nutrient composition data were not available for directly comparable cooking methods.

The only way that the difference in fat content for individual beef cuts could be determined would be by butchering Australian and American beef carcasses, using one cutting chart and then trimming each set of beef cuts to each country's retail level. This comparison could be conducted but is beyond the scope of the current study.

The current study has revealed that the NHF approved beef cuts are significantly leaner than the most comparable U.S.A., trimmed beef cuts ($p<0.01$). These differences are due to the differing livestock production methods and trimming practices in the two countries. The problems concerning the allocation of comparable beef cuts from overseas data, including different cut names and cooking methods also have been highlighted.

Klensin, J.C. (1993) identified that the varying descriptions of the same food items in different countries makes the comparison of overseas food items very difficult. While it is not envisaged that Australians will want to rely on such data in the future, universal cut names would make the comparisons of food items in overseas countries much more meaningful. These comparisons may become necessary in the future so as to trade items on the world market (e.g. beef).

It is evident that in the years prior to 1989, Australians utilised data derived from the most comparable overseas food items. These derived values would have been influenced by the many issues concerning overseas data that have been considered in this discussion. Thus, the need to continually provide up to date Australian nutrient data is paramount if accurate and meaningful nutrient information is to be provided to Australians.

## 5.3 SOME APPLICATIONS OF THESE BEEF COMPOSITION DATA

The need for accurate and up to date Australian nutrient composition data has been considered during this discussion. The value of up to date Australian data was revealed by comparing the nutrient data from the currently studied beef cuts, with comparable, untrimmed Australian and trimmed U.S.A. beef data.

These comparisons emphasised the influences that varying production methods, trimming practices and cooking methods have on nutrient composition data. The important public health applications of nutrient composition data also highlight the need for a national nutrient composition dataset which is up to date and representative of the national food supply.

The current study provided up to date nutrient composition data for a range of NHF approved, Australian beef cuts that had not previously been studied, or published in detail. This study was initiated due to the concerns of Australians about the role of fat intake and diet related disease, combined with confusion over the role of red meat in the diet. Although these nutrient composition data will be published in the *Australian Food Tables*, a number of applications of nutrient composition information could be utilised to provide Australian consumers with nutritional information about the lean beef cuts they demanded. These applications include:

### 5.3.1 AN INFORMATION SOURCE FOR THE MEDIA AND CONSUMERS

The existence of up to date nutrient composition data on the NHF approved beef cuts means that this information can be provided to consumers and the media. Food cards, which provide information about the nutrient content of each beef cut (e.g. fat, cholesterol, energy, protein, iron and zinc per 100 grams, per serve and as a percentage of the Recommended Daily Allowance) are one potential source of consumer information. These could be made available at retail outlets which supply NHF approved beef cuts.

The commencement of a supplementary, national media campaign would allow the provision of nutrition information about the NHF approved beef cuts, to a larger Australian audience.

### 5.3.2 AN EDUCATION TOOL

Dietitians and nutrition educators could utilise the knowledge gained from the current study to educate consumers about healthy food choices. Nutrient composition data forms the basis of all nutrition education messages, including the *Australian Dietary Guidelines* (English, R. and Lewis, J., 1991).

The Dietary Guideline; "Eat a diet low in fat and, in particular, low in saturated fat", is particularly important in countries like Australia, where dietary related disease is common (Department of Health, Housing and Community Services and the Health Department of Western Australia, 1993, p.1).

Many Australians are concerned about their intake of fat, and the role of red meat in the diet (Dangar Research, 1992). Thus new knowledge about the nutrient composition of lean Australian beef is an important nutrition resource. Nutrition educators can utilise this up to date information when educating people about the *Australian Dietary Guidelines*, and the importance of healthy food choices.

The provision of analysed recipes and/or daily meal plans which incorporate these beef cuts are another application of nutrient composition information (Foote, D., 1990). These would be useful in educating consumers about the nutritional value of lean Australian beef, and its role in a healthy diet.

### 5.3.3. TO DETERMINE FOOD POLICY

The *Australian Food and Nutrition Policy* included an objective on the monitoring and surveillance of the Australian Food System (Commonwealth Department of Health, Housing and Community Services, 1992). This objective is essential if appropriate and up to date recommendations about healthy food choices are to be made to Australians.

Objective one of the *Australian Food and Nutrition Policy* aims to improve the knowledge of Australians about healthy eating (Commonwealth Department of Health, Housing and Community Services, 1992). The existence of up to date nutrient composition data on the NHF approved beef cuts and this food policy, means that Australians can now be made aware that lean beef is a healthy food choice.

The applications of the nutrient composition information derived in the current study are numerous. However, these examples have revealed their important influence on the health of Australians.

This discussion has placed the findings of the current study within the context of the ongoing Australian food composition programme. The importance of accurate and up to date Australian nutrient data has been emphasised. A consideration of the applications of food composition data has revealed their impact on health promotion, health policy and nutrition education activities in Australia and thus their potential impact on Australia's health.

# CHAPTER SIX

## THE LIMITATIONS OF THE STUDY AND AREAS FOR FURTHER INVESTIGATION

# 6.0 THE LIMITATIONS OF THE CURRENT STUDY

## 6.0.1 THE NUTRIENT COMPOSITIONS OF THIRTEEN OF THE NHF APPROVED BEEF CUTS WERE CALCULATED, NOT ANALYSED

The current study involved the nutrient analyses of raw and cooked NHF approved beef mince. However, the nutrient compositions of the other thirteen NHF approved beef cuts (raw and cooked) were derived by the application of their raw gross compositions to the nutrient compositions of previously studied comparable beef cuts (Greenfield, H. et al., 1987, and Hutchison, G.I. et al., 1987a, and published in Cashel, K. et al., 1989). Cashel, K. (1990) stated that nutrient compositions of the separable fat and lean meat portions of the beef cuts studied in 1987 were provided so that future beef composition studies need only involve gross compositions. The use of this method was viewed as a means to reduce expense and thus encourage regular revisions of the nutrition compositions of Australian beef.

The current study was based on this principle. Although this methodology was recommended, it must be highlighted that the nutrient compositions on which the current derivations were based, are now between seven and eleven years old (English, R., 1990). During this time the analytical laboratories used for food analysis have changed, as have some of the standard methods of analysis

(Cashel, K., 1989). Thus, although a recommended method was utilised during the current study, its limitations must be considered.

The nutrient composition data derived from the current study are acceptable. However, it must be remembered that livestock production methods will influence these data (Hosking M. and Rogers, J., 1989). Therefore if major changes to livestock feeding and production methods had occurred in Australia since the previous beef studies, it would have been essential to analyse the complete nutrient compositions of each NHF approved beef cut.

### 6.0.2 PREVIOUS AUSTRALIAN BEEF STUDIES UTILISED COMPOSITE SAMPLES, NOT REPLICATE SAMPLES FOR NUTRITIONAL ANALYSES

The variations in nutrient content between the beef samples of each NHF approved cut are not evident from the current study. This limitation is apparent because the nutrient compositions of the NHF approved beef cuts were derived from previous beef composition studies (Greenfield, H. et al., 1987, and Hutchison, G.I. et al., 1987a). As these studies utilised composite samples for their nutrient analyses, no variations between the beef samples could be determined.

Although composite samples are an acceptable method of sample preparation, only replicate samples are able to reveal the variations in nutrient content between individual samples (Watson, M.J. et al., 1992). A complete nutrient analysis of each individual sample for each beef cut, using replicate samples, would have provided information about the variation of nutrient contents between individual beef samples.

Additionally, the mean fat content would have been able to be calculated for each individual beef cut. Therefore the presence or absence of a significant difference between the fat content of each individual, comparable beef cut, analysed in 1987 and 1993 could have been determined. The availability of this information could have been used to explain the significance of the increase since 1987 in the fat content of skirt steak.

### 6.0.3 THE BEEF SAMPLES WERE ALL PURCHASED FROM THE SYDNEY METROPOLITAN AREA

The range of NHF approved beef cuts studied are available across Australia. The current study involved the collection of a representative sample of cuts from the Sydney metropolitan area only. This limitation could not be avoided as the co-ordination of an Australia wide beef study would have been difficult. Additionally, the time to transport the beef samples to a central laboratory would have varied, which may have influenced the quality of the beef samples.

Previous Australian beef composition studies have gained their representative sample from the Sydney metropolitan area (Greenfield, H. et al., 1987, and Hutchison, G.I. et al., 1987a). Assuming that appropriate demographic and marketing variables are considered, the collection of a representative sample from a large metropolitan area is considered acceptable (Watson, M.J. et al., 1992; Holden, J.M. and Davis, C.S., 1993).

### 6.0.4 ALL FOOD COMPOSITION DATA HAVE LIMITATIONS

Food composition data will always have their limitations because foods are, "Biological materials" which show, "Natural variation in composition" (English, R.M. and Lewis, J.L., 1990, p.249). Many factors are known to influence food composition data including food production methods, seasonal and geographic variations, the sampling plan devised and the analytical methods used (English, R. and Lewis, J., 1991).

The food composition data presented in food tables will never be exactly indicative of the composition of a particular food item, due to these many environmental influences. It is paramount that the users of food composition data understand the source of these variations (English, R. and Lewis, J., 1991). Researchers conducting food composition studies also need to appreciate these sources of variation, as the sampling plan and analytical methods employed will ultimately maximise, or minimise, the inherent limitations of food composition data.

## 6.1 AREAS FOR FURTHER INVESTIGATION

### 6.1.1 THE COMPLETE NUTRITIONAL ANALYSIS OF AT LEAST ONE BEEF CUT IN FUTURE BEEF COMPOSITION STUDIES

The current study involved computations from previous Australian beef studies to determine the nutrient compositions of all of the raw and cooked NHF approved beef cuts (excepting lean beef mince). Although this method is less resource intensive, and is acceptable, it is not optimal.

The nutrient compositions of the raw and cooked NHF approved beef mince were determined because the gross composition of mince can not be determined. However, the age of the nutrient composition data from which the derived nutrient contents of the other beef cuts were based, may have influenced their accuracy.

A recommendation for future beef composition studies is that the ten samples of at least one of the beef cuts (other than lean beef mince) be collected and completely analysed. A comparison of these data with the data derived from the most comparable cut previously analysed would reveal the influence that trimming may have on the nutrient composition of the beef cut. The formation of composite samples for these analyses would be acceptable. However, a series of replicate samples would be preferred, providing the study budget allowed.

Complete nutritional analyses also should be conducted on a cooked beef sample (composite) or samples (replicates). A comparison of the nutrient compositions gained, with the data derived from previous nutrient composition data, would reveal the difference (if any) between using the analysed or derived method.

The presence of a significant difference in nutrient compositions would indicate the need for a study which involved the complete nutritional analysis of all of the beef cuts (raw and cooked). The absence of a significant difference would indicate that the use of derivations from previous composition studies is appropriate.

### 6.1.2 A DETERMINATION OF THE NUTRIENT COMPOSITION OF SIRLOIN STEAK

The current study reported that the NHF approved sirloin steak contained more fat than was expected. Incorrect trimming practices at the retail level may have been the cause of the higher than expected (above ten percent) fat content of the sirloin steak. However, the other thirteen raw beef cuts had fat contents of less than ten percent, as expected. For this reason it is recommended that the retail trimming practices for sirloin steak be investigated. The sirloin steak should then be reanalysed, as soon as is practicable.

The use of replicate samples would be encouraged for the complete nutritional analyses of raw and cooked sirloin steak. This would allow individual variations between samples to be identified.

This investigation would allow a comparison between the derived and analysed sirloin steak data. Such an analysis would reveal the appropriateness of the derivation method utilised in the current study. It also would allow an investigation of the fat content of the NHF approved sirloin steak between socio-economic areas, as well as over the Sydney metropolitan area.

### 6.1.3 THE NEED FOR REGULAR REVISIONS OF AUSTRALIAN BEEF COMPOSITION

The beef composition studies which provided the nutrient composition data for the *Composition of Foods, Australia* (Cashel, K. et al., 1989) were conducted between 1982 and 1986, and were initially published in 1987 (Greenfield, H. et al., 1987, and Hutchison, G.I. et al., 1987a). An additional study of untrimmed Australian beef was published in 1992 (Watson, M.J. et al., 1992).

It is recommended that regular, rather than intermittent, beef composition studies are conducted. The results of the reinvestigation of NHF approved sirloin steak may provide an indication of when the next complete nutritional analysis of raw and cooked Australian beef cuts (trimmed and untrimmed) is necessary. However, the initiation of complete nutritional analyses are recommended whenever feeding and/or livestock production methods change in Australia.

## 6.2 RECOMMENDATIONS FOR THE AUSTRALIAN MEAT AND LIVESTOCK CORPORATION

**(1)** To investigate the retail trimming practices for sirloin steak and then analyse the nutrient composition of the NHF approved sirloin steak, as soon as possible. It is recommended that this study involves the determination of the nutrient compositions of this beef cut, in its raw and cooked states, by analysis.

**(2)** The development of a funded programme which allows the regular revision of the nutrient compositions of all Australian beef cuts.

**(3)** To determine by analysis the nutrient compositions of at least one raw and cooked beef cut in future beef composition studies.

**(4)** To provide nutrient composition information whenever new beef cuts are launched.

# CHAPTER SEVEN

# CONCLUSIONS

## 7.0 CONCLUSIONS

This study has successfully determined the nutrient compositions of the fourteen National Heart Foundation (NHF) approved beef cuts, in their raw and cooked forms. It also contributed to the Australian nutrient dataset, new and long outstanding information about lean beef.

The nutrient compositions of the NHF approved beef cuts were most similar to the 'lean meat only' data of the untrimmed Australian beef cuts published in 1989 (Cashel, K. et al., 1989). The NHF approved beef cuts were significantly ($p<0.01$) leaner than the untrimmed, comparable beef cuts 'lean meat and fat' data published in 1989 (Cashel, K. et al., 1989). The removal of all of the visible selvedge fat from the NHF approved beef cuts was identified as responsible for their lean composition.

The NHF approved beef cuts also were significantly leaner ($p<0.01$) than the most comparable U.S.A., trimmed beef cuts (Anderson, B.A. and Hoke, I.M., 1990). Differing livestock production methods and levels of retail trimming were predicted to be responsible for these variances.

These comparisons indicated many discrepancies which contribute to inaccuracy when old or overseas data which may not be entirely representative of the food item are used in food datasets. Therefore, the availability of accurate and up to date Australian nutrient data is paramount for the many public health applications of nutrient composition data, which include health promotion, health policy and nutrition education.

These long awaited nutrient compositions have shown us that NHF approved beef cuts, being the leanest available, are a healthy red meat choice. Knowledge of their lean compositions should help to dispel the fears of the Australian public and health professionals about the fat content of red meat. Australian consumers who demanded leaner red meat should now feel confident that NHF approved beef can be included as part of a healthy daily diet.

# REFERENCES

AMLC (1992). Refer to Australian Meat and Livestock Corporation (1992).

AMLC (1993a). Refer to Australian Meat and Livestock Corporation (1993a).

AMLC (1993b). Refer to Australian Meat and Livestock Corporation (1993b).

Anderson, B.A., Lauderdale, G.L., and Hoke, I.M. (1986). ***Composition of Foods: Beef Products. Raw, Processed, Prepared.*** Washington D.C.: United States Department of Agriculture.

Anderson, B.A. and Hoke, I.M. (1990). ***Composition of Foods: Beef Products. Raw, Processed, Prepared.*** Washington D.C.: United States Department of Agriculture.

Anon. (1988). ***Lean beef making an impact in the marketplace.*** September, p.10-11.

Australian Bureau of Statistics (1986). ***Socio-Economic Indexes for Areas, N.S.W.***

Australian Meat and Livestock Corporation (1992). ***Lean and Low - Your Guide to Low Fat Eating with Lean Beef and Lamb.***

Australian Meat and Livestock Corporation (1993a). ***Report of Independent Meat Retailers Participating in the NHF Pick the Tick Program.***

Australian Meat and Livestock Corporation (1993b). ***Meat Marketing Trends,*** June: 1-12.

Buick, D. (1993). **The Laboratory Handling, Sample Preparation, Cooking and Analysis of the NHF Approved Beef Cuts.** Unpublished Report.

Cashel, K. (1989). Australian nutrient data tables. ***Food Australia***, 41,11:1034-1035.

Cashel, K. (1990). Compilation and scrutiny of food composition data. ***Supplement to Food Australia***, 42,8: 21-24, 28.

Cashel, K. and English, R. (1987). Meat and poultry consumption and composition. ***Food Technology in Australia***, 49,5: 185-186.

Cashel, K., Lewis, J., and English, R. (1989). ***Composition of Foods, Australia.*** Volume One. Canberra: Australian Government Publishing Service.

Church, C.F. and Church, H.M. (1963). ***Food Values of Portions Commonly Used.*** Philadelphia: Lippincott.

Clements, F.W. (1986). ***A History of Human Nutrition in Australia.*** Melbourne: Longman Cheshire Pty. Limited.

Commonwealth Department of Community Services and Health (1986). ***National Dietary Survey of Adults: 1983, No.1: Foods Consumed***. Canberra: Australian Government Publishing Service.

Commonwealth Department of Community Services and Health (1987). ***National Dietary Survey of Adults: 1983, No.2: Nutrient intakes.*** Canberra: Australian Government Publishing Service.

Commonwealth Department of Community Services and Health (1988). ***Dietary Guidelines for Australians,*** 2nd Edition, Canberra: Australian Government Publishing Service.

Commonwealth Department of Health, Housing and Community Services (1992). ***Food and Nutrition Policy.*** Canberra: Australian Government Publishing Service.

Cunningham, J.H. (1990). Sampling of foods for nutrient composition studies. ***Supplement to Food Australia,*** 42,8: 16-17, 28.

Dangar Research (1992). ***Report for the Australian Meat and Livestock Corporation.***

Darnton-Hill, I. and English, R. (1990). Nutrition in Australia - Deficiencies, excesses, and current policies. ***The Australian Journal of Nutrition and Dietetics,*** 47,2: 34-39.

Department of Health, Housing and Community Services and the Health Department of Western Australia (1993). ***The Dietary Guidelines for Australians.*** Canberra: Australian Government Publishing Service.

DeVries, J.W. (1993). AOAC international-validated methods for nutrient analysis - Method availability and method needs, Sydney, ***Programme and Abstracts of the First International Database Conference***, p.17.

English, R. (1981). Australian food tables - some glimpses into the past. ***Food Technology in Australia***, 33,3: 103-106.

English, R. (1987). Introduction to the meeting, setting the scene for OCEANIAFOODS, Canberra, ***Proceedings of the First Conference,*** p.9-10.

English, R. (1990). Composition of foods, Australia. ***Supplement to Food Australia,*** 42, 8: 5-7.

English, R.M. and Lewis, J.L. (1990). Food composition tables for Australians, Adelaide, ***Proceedings of the Nutrition Society of Australia***, p.246-249.

English, R. and Lewis, J. (1991). ***Nutritional Values of Australian Foods.*** Department of Community Services and Health. Canberra: Australian Government Publishing Service.

Fantini, L. (1988). Developments in the meat and livestock industry in response to changing nutrition issues. ***Journal of Food and Nutrition***, 45,4: 100-103.

Fantini, L. (1990). Food composition data in the promotion of lean meat in Australia. ***Supplement to Food Australia***, 42,8: 25-28.

Fantini, L. and MacDonald, N.A. (1987). Trends in meat consumption in Australia 1938-39 to 1983-84. ***Food Technology in Australia***, 39,5: 187-190.

Foote, D. (1990). Food composition data and clinical dietetics. ***Supplement to Food Australia,*** 42,8:8-9.

Greenfield, H. and Wills, R.B.H. (1979). Composition of Australian Foods 1. Tables of food Composition and the need for comprehensive Australian tables. ***Food Technology in Australia***, November: 458-463.

Greenfield, H., Kuo, Y.L., Hutchison, G.I., and Wills, R.B.H. (1987). Composition of Australian Foods 34, beef and veal. ***Food Technology in Australia,*** 39,5: 208-215, 227.

Greenfield, H. and Southgate, D.A.T. (1992). ***Food Composition Data - Production, Management and Use.*** Essex: Elsevier Science Publishers.

Haddy, B. (1990). Food composition data and the National Heart Foundation's food approval program. ***Supplement to Food Australia,*** 42,8: 14-15.

Holden, J.M., and Davis, C.S. (1993). Strategies for sampling: The assurance of representative values, Sydney, ***Programme and Abstracts of the First International Food Database Conference***, p.33.

Hood, R.L. (1987). A note on the cholesterol content of beef rib steaks. ***CSIRO Food Research Quarterly***, 47: 44-46.

Hosking, M. and Rogers, J. (1989). ***A Review of Beef, Veal, and Lamb in the Australian Diet.*** Camperdown: The Australian Nutrition Foundation Inc.

Hutchison, G.I., Thomas, D.E., and Truswell, A.S. (1987a). Nutrient composition of Australian beef. ***Food Technology in Australia,*** 39,5: 199-201.

Hutchison, G.I., Thomas, D.E., and Truswell, A.S. (1987b). Nutrient composition of Australian chicken. ***Food Technology in Australia,*** 39,5: 196-198.

Klensin, J.C. (1993). Data identification considerations in international interchange of food composition data, Sydney, ***Programme and Abstracts of the First International Food Database Conference***, p.45.

Lewis, J.L. (1993). **The Methods of Computation Used to Determine the Nutrient Compositions of the NHF Approved Beef Cuts.** Unpublished Report.

Lewis, J. and Holt, R. (1991). ***NUTTAB 91-92 Nutrient Data Tables for Use in Australia.*** Canberra: Australian Government Publishing Service.

Lewis, J.L., Sadler, M., and Buick, D.R. (1993). Composition of retail beef cuts trimmed of fat. ***Supplement to Food Australia,*** 45,11: S1-S19.

McCance, R.A., and Widdowson, E.M. (1960). ***The Chemical Composition of Foods.*** London: HMSO.

National Health and Medical Research Council (1992). ***The Dietary Guidelines for Australians.*** Canberra: The Australian Government Publishing Service.

National Heart Foundation of Australia (1992). ***Guidelines for Acceptability of National Heart Foundation Approved Products.***

Osmond, A. and Wilson, W. (1954). ***Tables of Composition of Australian Foods.*** Canberra: Government Printing Office.

Paul, A.A. and Southgate, D.A.T. (1978). ***McCance and Widdowson's The Composition of Foods,*** 4th Edition, London: HMSO.

Sadler, M., Lewis, J., and Buick, D., (1993). Nutrient composition of trim lamb. ***Supplement to Food Australia***, 45,11:In press.

Savell, J.W. (1990). Nutrient composition of beef. ***Food and Nutrition News,*** 62,4: 24-25.

Savell, J.W., Cross, H.R., Hale, D.S., and Beasley, L. (1988). National Beef Market Basket Survey. ***Final report to National Cattlemen's Foundation Inc., Meats and Muscle Biology Section, Department Animal Science, Texas Agricultural Experiment Station, Texas, A&M University,*** p.1-6.

Scheelings, P. and Buick, D. (1990). Data production and quality assurance in a nutrient analysis program. ***Supplement to Food Australia,*** 42,8: 18-20.

Sinclair, A.J. and O'Dea, K. (1987). The lipid levels and fatty acid compositions of the lean portions of Australian beef and lamb. ***Food Technology in Australia,*** 39,5: 228-231.

Smith, G.C., Savell, J.W., and Cross, H.R. (1987). State of the art - Where are we, in 1987, on fatness, fat, and fatty acids of beef. ***Meat Research Update,*** 2,3: 1-10.

Souci, S.W., Fachmann, W., and Kraut, H. (1962). ***Die Zusammensetzung der Lebensmittel. Nahrwertlabellen stuttgart:*** Wissenchaftliche Verlagsgesellschaft.

Sweeten, M.K., Cross, H.R., Smith, G.C., Savell, J.W., and Smith, S.B. (1990). Lean beef: Impetus for lipid modifications. ***Journal of the American Dietetic Association,*** 90: 87-92.

Thomas, S. and Corden, M. (1970). ***Tables of Composition of Australian Foods.*** Canberra: Australian Government Publishing Service.

Thomas, S. and Corden, M. (1977). ***Metric Tables of Composition of Australian Foods.*** Canberra: Australian Government Publishing Service.

Thompson, M. (1993). **Sample Selection of Butchers for the Australian Meat and Livestock Corporation NHF Beef Study.** Unpublished Report.

Thomson, N.J. (1992). ***Australia's Health. The Third Biennial Report of the Australian Institute of Health and Welfare.*** Canberra: The Australian Government Publishing Service.

Thornton, R.F., Tume, R.K., Larsen, T.W., Johnson, G.W., and Sexton, W.R. (1987). Fat content of popular cuts of meat: cooked and raw. ***CSIRO Food Research Quarterly,*** 47: 30-37.

Tolisson, B. (1993). Domestic retail sales trends. ***Meat and Livestock Review,*** March: 12-13.

Walker, D.J. (1988). Trends in the Australian meat industry. ***Food Australia,*** 40,10: 418-421.

Watson, M.J., Mann, N.J., Sinclair, A.J., and O'Dea, K. (1992). Fat content of untrimmed retail beef and lamb cuts 1. ***Food Australia,*** 44,11: 511-518.

Watt, B.K. and Merrill, A.L. (1963). ***Composition of Foods: Raw, Processed, Prepared.*** Washington D.C.: United States Department of Agriculture.

Windham, C.T., Schvaneveldt, N.B., Wyse, B.W., and Hansen, R.G. (1987). Using food composition data to communicate nutrition to the consumer. In Rand, W.M., Windham, C.T., Wyse, B.W., and Young, V.R. (eds.). ***Food Composition Data: A User's Perspective.*** Tokyo: The United Nations University.

# BIBLIOGRAPHY

Australian Meat and Livestock Corporation. ***Annual Report.*** 1 July, 1991 - 30 June, 1992.

Cashel, K. (1987). The revision of Australian food composition data, Canberra , ***Proceedings of the First OCENIAFOODS Conference,*** p.24-27.

Truswell, A.S. (1981). Australian tables of food composition: Current status. ***Food Technology in Australia,*** 33,3:108-109.

Wills, R.B.H., Balmer, N., and Greenfield, H. (1980). Composition of Australian foods. 2. Methods of analysis. ***Food Technology in Australia,*** 32,4:198-204.

Wills, R.B.H., and Greenfield, H. (1981). Methodological considerations in producing data for food composition tables. ***Food Technology in Australia,*** 33,3:122-124.

# APPENDICES

# APPENDIX 1

## A STUDY OF AUSTRALIAN BEEF COMPOSITION

These tables were compiled from the beef composition data contributed by the study of; Greenfield, H. Kuo, Y.L., Hutchison, G.I., and Wills, R.B.H. (1987), ***Food Technology in Australia,*** 39,5: 208-215, 227.

**Table 1: The Gross Composition of Beef**

| Beef Cut | Cooking Method Plus Weight Loss on Cooking (%) | Mean Item Weight (g) | Lean (%) | Fat (%) | Bone (%) | Gristle (%) | Dissection drip (by difference) (%) | Edible portion (lean + fat/total (%) |
|---|---|---|---|---|---|---|---|---|
| Fillet steak | | | | | | | | |
| raw | - | 116 | 88 | 10 | 0 | 2 | 0 | 98 |
| cooked | Grilled, 10 mins./ steak (31%) | - | 87 | 9 | 0 | 4 | 0 | 96 |
| Rump steak | | | | | | | | |
| raw | - | 320 | 81 | 18 | 0 | 1 | 0 | 99 |
| cooked | Grilled 15 mins./ steak (36%) | - | 83 | 14 | 0 | 1 | 2 | 97 |
| Silverside, non-corned | | | | | | | | |
| raw | - | 621 | 85 | 12 | 0 | 3 | 0 | 97 |
| cooked | Roasted, 90 min./ cut, 170°C (36%) | - | 83 | 9 | 2 | 6 | 0 | 92 |
| Skirt steak | | | | | | | | |
| raw | - | - | 97 | 2 | 0 | 1 | 0 | 99 |
| cooked (2cm cubes) | Stewed, 15 min./ 250ml/500g (42%) | - | 95 | 2 | 0 | 1 | 2 | 97 |

(Greenfield, H. et al., 1987, p.209)

**<u>Table 2: The Proximate, Vitamin, and Mineral Composition of Beef per 100g Edible Portion</u>**

| Beef Cut | Water (g) | Protein (g) | Fat (g) | Ash (g) | Energy (kJ) | Thiamin (mg) | Riboflavin (mg) | Niacin (mg) | Retinol (mg) | β-Carotene (mg) | Sodium (mg) | Potassium (mg) | Calcium (mg) | Iron (mg) | Magnesium (mg) | Zinc (mg) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| <u>Fillet steak</u> | | | | | | | | | | | | | | | | |
| raw (lean + fat) | 69.9 | 20.1 | 10.7 | 1.1 | 737 | 0.12 | 0.23 | 3.9 | 0 | - | 46 | 350 | 4 | 3.2 | 20 | 3.1 |
| cooked (lean + fat) | 58.8 | 28.7 | 13.1 | 1.4 | 974 | 0.12 | 0.31 | 5.6 | 0 | - | 58 | 370 | 5 | 3.9 | 21 | 4.2 |
| <u>Rump steak</u> | | | | | | | | | | | | | | | | |
| raw (lean + fat) | 62.2 | 20.0 | 16.7 | 0.9 | 915 | 0.09 | 0.22 | 4.1 | 0 | 0 | 44 | 330 | 6 | 2.5 | 17 | 3.5 |
| cooked (lean + fat) | 53.9 | 29.5 | 16.8 | 1.1 | 1124 | 0.09 | 0.32 | 5.7 | 0 | 0 | 52 | 340 | 6 | 3.6 | 17 | 4.6 |
| <u>Silverside non-corned</u> | | | | | | | | | | | | | | | | |
| raw (lean + fat) | 67.5 | 20.5 | 11.8 | 0.9 | 780 | 0.08 | 0.21 | 2.4 | 0.01 | - | 45 | 340 | 3 | 2.3 | 18 | 3.0 |
| cooked (lean + fat) | 56.4 | 31.5 | 11.7 | 1.0 | 969 | 0.08 | 0.34 | 3.7 | 0.01 | - | 49 | 320 | 5 | 3.7 | 20 | 4.9 |
| <u>Skirt Steak</u> | | | | | | | | | | | | | | | | |
| raw (lean + fat) | 73.7 | 22.2 | 3.6 | 1.2 | 511 | 0.06 | 0.24 | 4.2 | 0 | - | 64 | 330 | 5 | 1.8 | 20 | 5.5 |
| cooked (lean + fat) | 58.9 | 35.2 | 6.3 | 1.1 | 829 | 0.04 | 0.39 | 6.6 | 0 | - | 64 | 260 | 5 | 2.7 | 20 | 10.4 |

(Greenfield, H. et al, 1987, p.210-211).

**<u>Table 3: The Cholesterol Content of Beef per 100g Edible Portion</u>**

| Beef Cut | Cholesterol (mg) |
| --- | --- |
| <u>Non-Corned Beef</u> | |
| Raw (lean + fat) | 71 |
| Cooked (lean + fat) | 86 |
| (Greenfield, H. et al., 1987, p.211) | |

## APPENDIX 2

## A FURTHER STUDY OF AUSTRALIAN BEEF COMPOSITION

These tables were compiled form the beef composition data contributed by the study of; Hutchison, G.I., Thomas, D.E., and Truswell, A.S. (1987a), ***Food Technology in Australia,*** 39,5: 199-201.

**Table 1: The Methods Used to Cook the Beef Cuts**

| Beef Cut | Cooking Method |
|---|---|
| Blade Steak | Vertical Griller at maximum heat for 10 minutes |
| Round Steak | Vertical Griller at maximum heat for 10 minutes |
| Sirloin Steak | Vertical Griller at maximum heat for 10 minutes |
| Topside Roast | Dry pan for 30 minutes/500g at 180-200°C in a gas oven |
| Mince | Simmered in water (250ml/500g) for 20 minutes, and then drained |

(Hutchison, G.I. et al., 1987, p.199)

**Table 2: The Proximate, Vitamin, and Mineral Composition of Beef per 100g Edible Portion**

| Beef Cut | Water (g) | Energy (kJ) | Protein (g) | Fat (g) | Sodium (mg) | Potassium (mg) | Calcium (mg) | Iron (mg) | Magnesium (mg) | Zinc (mg) | Retinol (mg) | Thiamin (mg) | Riboflavin (mg) | Niacin (mg) | Cholesterol (mg) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Blade Steak | | | | | | | | | | | | | | | |
| raw (lean + fat) | 69.1 | 692 | 20.4 | 9.3 | 66 | 358 | 17 | 2.5 | 18 | 4.4 | <0.01 | 0.07 | 0.15 | 3.8 | 56 |
| cooked (lean + fat) | 60.8 | 910 | 27.7 | 11.9 | 74 | 362 | 23 | 2.6 | 21 | 6.4 | <0.01 | 0.10 | 0.20 | 4.0 | 72 |
| Round Steak | | | | | | | | | | | | | | | |
| raw (lean + fat) | 70.0 | 678 | 20.0 | 9.1 | 54 | 304 | 4 | 1.4 | 26 | 4.0 | <0.01 | 0.06 | 0.15 | 3.5 | 53 |
| cooked (lean + fat) | 59.8 | 908 | 29.0 | 11.2 | 65 | 337 | 5 | 2.0 | 36 | 6.0 | <0.01 | 0.08 | 0.16 | 4.0 | 71 |
| Sirloin Steak | | | | | | | | | | | | | | | |
| raw (lean + fat) | 63.5 | 921 | 19.3 | 16.0 | 63 | 349 | 21 | 1.8 | 19 | 3.4 | <0.01 | 0.07 | 0.10 | 4.7 | 51 |
| cooked (lean + fat) | 55.4 | 1092 | 25.6 | 16.0 | 78 | 336 | 26 | 3.0 | 23 | 4.8 | <0.01 | 0.09 | 0.12 | 5.2 | 62 |
| Topside Roast | | | | | | | | | | | | | | | |
| raw (lean + fat) | 70.8 | 602 | 21.0 | 6.6 | 56 | 310 | 4 | 2.0 | 29 | 3.3 | <0.01 | 0.08 | 0.14 | 5.8 | 48 |
| cooked (lean + fat) | 63.5 | 801 | 25.2 | 10.1 | 58 | 296 | 5 | 2.7 | 32 | 3.9 | <0.01 | 0.10 | 0.16 | 5.6 | 64 |
| Mince | | | | | | | | | | | | | | | |
| raw | 68.1 | 738 | 19.9 | 10.8 | 93 | 297 | 7 | 2.3 | 29 | 4.1 | <0.01 | 0.07 | 0.14 | 3.8 | 63 |
| boiled, drained | 66.3 | 764 | 23.6 | 9.8 | 57 | 262 | 9 | 2.3 | 24 | 5.2 | 0 | 0.05 | 0.13 | 2.1 | 69 |

(Hutchison, G.I. et al, 1987, p.200-201).

# APPENDIX 3

## THE FAT CONTENT (PER 100 GRAMS) OF THE COMPARABLE BEEF CUTS PRESENTED IN THE 1989 FOOD COMPOSITION TABLES

| Beef Cut | Fat Content (g per 100 grams) | | | |
|---|---|---|---|---|
| | Lean Only | 75% Fat Trimmed | 50% Fat Trimmed | Lean Meat and Fat |
| Fillet Steak (raw) | 4.2 | 6.0 | 7.6 | 10.7 |
| Fillet Steak (grilled) | 8.3 | 9.6 | 10.9 | 13.2 |
| Rump Steak (raw) | 2.6 | 6.7 | 10.4 | 16.7 |
| Rump Steak (grilled) | 6.7 | 9.5 | 12.2 | 16.8 |
| Silverside non-corned (raw) | 2.2 | 4.8 | 7.3 | 11.7 |
| Silverside non-corned (baked) | 4.6 | 6.6 | 8.3 | 11.7 |
| Skirt Steak (raw) | 2.4 | 2.7 | 3.1 | 3.7 |
| Skirt Steak (simmered) | 4.9 | 5.2 | 5.6 | 6.2 |
| Blade Steak (raw) | 5.0 | 6.5 | 8.0 | 10.8 |
| Blade Steak (grilled) | 6.8 | 7.8 | 8.8 | 10.6 |
| Round Steak (raw) | 3.7 | 5.0 | 6.3 | 9.1 |
| Round Steak (grilled) | 6.2 | 7.1 | 8.0 | 9.6 |
| Sirloin Steak (raw) | 5.9 | 9.1 | 12.0 | 17.2 |
| Sirloin Steak (grilled) | 8.8 | 11.7 | 14.4 | 19.1 |
| Topside Roast (raw) | 3.2 | 4.1 | 5.0 | 6.7 |
| Topside Roast (baked) | 4.9 | 6.3 | 7.6 | 10.0 |
| Regular Beef Mince (raw) | - | - | - | 10.8 |
| Regular Beef Mince (simmered, drained) | - | - | - | 9.8 |

(Cashel, K. et al., 1989)

# APPENDIX 4

## SAMPLE SELECTION OF BUTCHERS FOR THE AUSTRALIAN MEAT AND LIVESTOCK CORPORATION NHF BEEF STUDY*

This report was submitted to the Australian Meat and Livestock Corporation by Mr. M. Thompson (Statistical Consultant, Australian Bureau of Statistics, Sydney) for publication in the ***Supplement to Food Australia,*** 45, 11: S1-S19.

### METHODOLOGY

### Meat Purchases

Beef cuts were purchased from retail outlets distributed across the socio-economic levels of Sydney. The selection process had three stages:

1. Selection of socio-economic areas throughout Sydney metropolitan area.
2. Selection of retail outlets.
3. Allocation of beef cuts to retail outlets.

### Selection of socio-economic areas

A list of 37 Local Government areas (LGA's) in the Sydney Metropolitan area were ranked in socio-economic order where their socio-economic level was determined using the urban index of relative socio-economic advantage (Australian Bureau of Statistics, 1986).

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* This title is a summary of this unpublished report and not the official title for publication.

A selection of ten areas was made to provide a spread of areas across the different socio-economic levels. The areas were selected using systematic sampling. This involves ordering the LGA's by socio-economic level then selecting a random starting point in the cumulative population of the LGA's. A fixed skip interval is then used to select further areas.

**Selection of retail outlets**

A random selection of supermarkets and butchers from the Australian Meat and Livestock Corporation (AMLC) database was made in each of the ten areas. To reflect national sales trends the retail outlets were selected so that 60% of the outlets were butchers and 40% were supermarkets (Australian Meat and Livestock Corporation, 1993).

**Table 1: The Allocation of Beef* Cuts to Retail Outlets**

| | LGA 1 | LGA 2 | LGA 3 | LGA 4 | LGA 5 |
|---|---|---|---|---|---|
| Outlet 1 | LIE | EDK | CHI | GNJ | GD |
| Outlet 2 | CM | CF | JNM | KCD | MFJ |
| Outlet 3 | FKJ | NHI | GB | HMF | BLI |
| Outlet 4 | DGA | LBJ | LEK | IB | KNC |
| Outlet 5 | BNH | MGA | ADF | AEL | AEH |

| | LGA 6 | LGA 7 | LGA 8 | LGA 9 | LGA 10 |
|---|---|---|---|---|---|
| Outlet 1 | EJG | LEN | BEL | KJA | ELM |
| Outlet 2 | HNC | BAD | HD | MFB | AHJ |
| Outlet 3 | FM | HKG | AGJ | EGN | NCG |
| Outlet 4 | IKA | CF | NIK | LC | DI |
| Outlet 5 | BLD | JIM | FCM | DJH | BKF |

* Beef cuts are represented by a cut code A → N, as detailed in Table 3.1.

**Allocation of beef cuts to retail outlets**

Each of the beef cuts were purchased in each of the ten socio-economic areas. The beef cuts were randomly allocated between the appropriate retail outlets with not more than three cuts purchased from any one outlet (Table 1). A total of 10 purchases was made for each of the beef cuts.

**REFERENCES**

Australian Bureau of Statistics (1986). ***Socio-Economic Indexes for Areas, N.S.W.***

Australian Meat and Livestock Corporation (1993). ***Meat Marketing Trends,*** June: p.1-12.

# APPENDIX 5

## THE LABORATORY HANDLING, SAMPLE PREPARATION, COOKING AND ANALYSIS OF THE NHF APPROVED BEEF CUTS*

This report was submitted to the Australian Meat and Livestock Corporation by D.R. Buick (Principal Chemist, Australian Government Analytical Laboratories, Seaton, S.A.) for publication in the *Supplement to Food Australia*, 45, 11: S1-S19.

The beef samples were received in the laboratory late on the day of purchase and stored overnight in a domestic refrigerator or until prepared. Each sample was individually identified by number. Dissection of raw samples began next morning with each sample being unpacked and weighed. Each of the ten samples was separated into lean meat, fat, and gristle. Each sample was weighed and a dissection loss calculated. The gross composition for each of the 13 cuts of fat-trimmed beef was calculated from the average results obtained on the ten purchases and is reported in Table 1.

The sample preparation was carried out as rapidly as possible with several workers simultaneously separating like samples. These were covered with aluminium foil or kept in the vacuum packs while not in preparation.

The lean beef mince samples for raw analysis were individually mixed and then equal amounts homogenised together in a DAMPA CT 35 cutter to form a raw composite sample for analysis. The lean beef mince samples for cooked analysis were individually mixed and then equal

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* This title is a summary of this unpublished report and not the official title for publication.

amounts dry pan fried together until colour change. The cooked mince was then homogenised together in a DAMPA CT 35 cutter to form a cooked composite sample for analysis.

Each composite was allocated a unique laboratory report number to facilitate sample tracking through the laboratory. Raw and cooked homogenates were stored in polycarbonate screw top jars in a refrigerator or freezer at -18°C until analysed. Reserve samples were also frozen for future reference.

**Analysis**

Moisture determinations were begun on the day following sample preparation. Water- and oil-soluble vitamins were determined next in order to minimise exposure to light, heat, oxidation or other decomposition mechanisms. Proximate and mineral analyses were given lower priority provided the sample integrity was preserved by refrigeration or freezing.

**Analytical Methods**

**Proximates:** Moisture was determined by oven drying at 102°C to constant weight, fat was determined by soxhlet extraction with diethyl ether for 16 hours followed by drying to constant weight. Total nitrogen was determined by the Kjeldahl method using a Tecator block digester DS-6 and a Kjeltec 1026 distilling unit. Ash was determined by ignition in a muffle furnace at 550°C.

**Vitamins:** Thiamin and riboflavin were extracted by acid and enzymatic hydrolysis and determined by reverse phase high pressure liquid chromatography (HPLC) and fluorescence detection using a Waters autosampler, a Waters 501 pump and a Hitachi F1000 fluorescence detector. Thiamin was assayed as thiochrome after post column oxidation by alkaline potassium ferricyanide (Wimilasiri, R. and Wills, R.B.H., 1985). Niacin was determined colorimetrically by the Konig reaction with cyanogen bromide after alkaline extraction and includes both niacinamide and nicotinic acid (Association of Official Analytical Chemists, 1984).

Cholesterol was extracted from the sample using petroleum ether after preliminary hydrolysis with alcoholic potassium hydroxide. Cholestane was added as an internal standard, the ether evaporated and the cholesterol converted to cholesterol acetate using acetic anhydride in pyridine at 80°C. Cholesterol acetate was determined by capillary gas chromatography on a 12m non-polar bonded phase column (SGE, 12QC2, BP1) using hydrogen as a carrier gas and a temperature program.

Vitamin B-12 was determined by microbiological assay using *Euglena gracilis* Krebs following extraction with an acetate buffer (Association of Official Analytical Chemists, 1984). Vitamin B-6 was determined by microbiological assay using *Saccharomycesuvarium* ATCC 9080, following extraction with 1N $H_2SO_4$ (Association of Official Analytical Chemists, 1984).

**Minerals.** Several different ashing or digestion procedures were used for different minerals or trace elements in order to achieve complete ashing or digestion of samples whilst ensuring no losses or contamination occurred. Sodium and potassium were determined by flame atomic absorption spectrophotometry (AAS) on a Perkin Elmer 4100 AAS using caesium as an ionisation suppressant after wet ashing the sample in nitric acid. Magnesium, iron, and zinc were determined after dry ashing at 500°C in a muffle furnace and the ash dissolved in dilute nitric acid. These elements were determined by flame AAS, with the exception of phosphorus which was determined by colorimetry using molybdo-vanadate reagent and a GBC 911A visible spectrophotometer at 460nm.

Fatty acid profiles were determined on several pooled samples by extraction of lipids using chloroform: methanol following the method of Bligh and Dyer (Bligh, E.G. and Dyer, W.J., 1959). The extracted lipids containing glycerides, phosopholipids, glycolipids and free fatty acids are trans-esterified using sodium methoxide in methanol or esterified with sulphuric acid in methanol. The methyl esters are then re-extracted from alkaline solution using hexane and determined on a 25m polar bonded phase capillary column (SGE, 25Q2/BPX-70) using hydrogen as the carrier gas and temperature program on a Varian 3400 GLC with a flame ionisation detector.

Calcium and phosphorus were determined after dry ashing at 500°C in a muffle furnace and the ash dissolved in dilute nitric acid. Calcium was determined by flame atomic absorption spectrophotometry; phosphorus was determined by colorimetry using molybdo-vanadate reagent and a GBC911A visible spectrophotometer at 460nm.

Retinol was extracted from the sample using petroleum ether after preliminary hydrolysis with alcoholic potassium hydroxide. The extract was taken to near dryness under vacuum and blown down with nitrogen before dissolution in methanol. Retinol was analysed by reverse phase HPLC on a C18 Nova Pak radial compression column using methanol: water as a mobile phase. Retinol was detected using a Waters 490 ultra-violet detector at 325nm.

Vitamin C as determined by reverse phase high pressure liquid chromatography on a C18 Nova Pak column using 0.2% orthophosphoric acid as the mobile phase and ultra violet detection at 254nm after extraction of the sample aliquot with 3% metaphosphoric acid.

ß-carotene was determined on the same extract used for retinol analysis by reverse phase HPLC on the same HPLC column, the mobile phase being methanol: tetrahydrofuran 90:0, detection was at 450nm.

**Analytical quality assurance**

To ensure the reliability of all results, methods chosen for these analyses had been previously subjected to a rigorous process of validation involving replicate analyses of a variety of sample matrices, replicate analyses of samples spiked at different levels and, where available, analyses standard reference materials. This evaluation process is carried out as an integral part of the laboratories Good Laboratory Practice (GLP) protocol (Association of Official Analytical Chemists, 1984). Ongoing participation in AGAL analytical quality assurance studies and in national and international proficiency studies provides further assurance of the validity of the methodology and the operator's ability to carry out the work.

All results reported herein were performed in analytical batches which included reagent blanks, recoveries, control samples and standard reference materials when appropriate. Many analyses were performed in duplicate. Results and quality assurance measures were carefully scrutinised to ensure the individual results are valid and where possible results were compared with previous published data to provide an added measure of confidence.

**Table 1: The Gross Compositions of the Raw, NHF Approved Beef Cuts**

| NHF Approved Beef Cut | Mean Weight (g) | Lean (%) | Fat (%) | Gristle (%) | Dissection Loss (%) | Relative Proportions Lean (%) | Relative Proportions Fat (%) |
|---|---|---|---|---|---|---|---|
| Eye fillet steak | 270 | 91 | 5 | 3 | 1 | 95 | 5 |
| Eye fillet roast | 500 | 92 | 4 | 3 | 2 | 96 | 4 |
| Rump steak | 240 | 91 | 4 | 3 | 2 | 96 | 4 |
| Silverside steak | 275 | 95 | 1 | 2 | 1 | 99 | 1 |
| Silverside roast | 955 | 95 | 2 | 2 | 2 | 98 | 2 |
| Skirt steak | 310 | 93 | 3 | 3 | 1 | 97 | 3 |
| Blade steak, boneless | 255 | 94 | 2 | 4 | 1 | 98 | 2 |
| Round steak | 265 | 92 | 4 | 3 | 1 | 96 | 4 |
| Sirloin steak | 240 | 88 | 7 | 4 | 1 | 93 | 7 |
| Topside steak | 280 | 95 | 2 | 2 | 1 | 98 | 2 |
| Topside roast | 1140 | 94 | 3 | 2 | 2 | 97 | 3 |
| Topside strips | 305 | 94 | 2 | 2 | 3 | 98 | 2 |
| Topside cubes | 300 | 95 | 1 | 1 | 3 | 99 | 1 |

**REFERENCES**

Association of Official Analytical Chemists (1984). ***Official Methods of Analysis*** (14th Edition) 43: 048-050, 229-234.

Bligh, E.G., and Dyer, W.J. (1959). A rapid method of total lipid extraction and purifications, ***Canadian Journal of Biochemical Physiology,*** 37: 911-917.

Wimilasiri, R. and Wills, R.B.H. (1985). Simultaneous analysis of thiamin and riboflavin in foods by high performance liquid chromatography. ***Journal of Chromatography***, 318: 412-416.

# APPENDIX 6

## THE METHODS OF COMPUTATION USED TO DETERMINE THE NUTRIENT COMPOSITIONS OF THE NHF APPROVED BEEF CUTS*

This report was submitted to the Australian Meat and Livestock Corporation for publication by J.L. Lewis (Senior Nutritionist at the National Food Authority, Canberra, A.C.T.) for publication in the ***Supplement to Food Australia***, 45, 11: S1-S19.

### Source of gross composition and nutrient data

The nutritional values and gross composition data for meat given in *Composition of Foods, Australia* (COFA) (Cashel, K. et al., 1989) were used as the basis for the calculations described below. These data are largely based on the comprehensive beef studies of Greenfield & others (Greenfield, H. et al., 1987) and Hutchison & others (Hutchison, G.I. et al., 1987) conducted in the early 1980s. The nutritional profiles of the fat components of individual cuts were not published in COFA, but were available to the authors of this paper. Similarly, phosphorus values from the database version NUTTAB91-92 (Lewis, J. and Holt, R., 1991) were included in the profiles. Data for raw, and cooked lean beef mince were obtained directly by analysis. The conversion factors for calculation of energy content, niacin equivalents, retinol equivalents and the lipid conversion factor for fatty acids were consistent with those used in COFA.

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* This title is a summary of this unpublished report and not the official title for publication.

**Raw trimmed cuts**

For the purposes of calculating the nutrient composition of raw trimmed beef cuts per 100g edible portion, the proportions of the lean and fat components dissected as purchased, were expressed as relative proportions of the sum of the lean and fat components. Although the dissection loss was likely to be truly edible, it was not considered as such because there was no information about its lean and fat composition to allow its contribution to those components to be confidently assigned. In effect, the same results would have been achieved if the dissection loss was assumed to have the same lean and fat composition as the cut itself. In addition, the treatment of the data in that way was consistent with the compilation procedure for meat data in COFA (Cashel, K. et al., 1989). The adjusted relative proportions of lean and fat were used to compile the nutrient profiles of the raw trimmed cuts per 100g edible portion given in Table 2. Although given as whole numbers in Table 1, the proportions of lean and fat were expressed to one decimal place when applied to the nutrient data for the lean and fat components.

**Cooked trimmed cuts**

**Application of estimated cooking losses:** To estimate the nutrient composition of cooked cuts, the proportions of both the lean and fat components after cooking need to be determined. Where gross composition information is confined to raw cuts, and there are no such data for their cooked counterparts as in this case, theoretical cooked lean and fat proportions can be calculated from known gross and proximate composition data of reference cuts.

The percentage losses of lean and of fat in equivalent or similar reference cuts cooked by the methods recommended by the AMLC were required to compile the nutrient composition of the trim cuts. The losses were calculated from:

- the same cut cooked by an equivalent cooking method,
- or a similar cut cooked by an equivalent method.

For 7 of the 13 trim cuts, percentage loss data were able to be matched to the same cut and recommended cooking method reported in COFA (Cashel, K. et al., 1989). For example, the losses on cooking calculated from published data for COFA 081A1-017 fillet steak, raw, and COFA 08A1-019 fillet steak, grilled lean and fat, were applied to raw trim eye fillet steak, to estimate the composition of grilled trim eye fillet steak.

For the new trim cuts such as silverside steak, losses determined from other cuts cooked by the appropriate recommended method were applied. For some cooking methods, data were available from a number of cuts. The selection of appropriate percentage losses for new cuts was based on the representativeness of the available data for the same cooking method across several cuts, and the carcass proximity of the two raw cuts being related. For example, the cooking losses for the reference grilled fillet steak were used to estimate grilled trim silverside steak. Round steak however, was previously published as grilled, but as stewing was the recommended method for the trim version of this cut, the losses for stewed skirt steak were applied.

**Estimation of cooking losses:** The losses on cooking for the individual lean and fat components of the selected reference cuts, were calculated from the moisture and fat contents of the raw and cooked forms of the lean or fat according to the following formula:

$$x = \frac{100\,[(\%\ moisture_r + \%\ fat_r) - (\%\ moisture_c + \%\ fat_c)]}{100 - (\%\ moisture_c + \%\ fat_c)}$$

where:

x - is the % cooking loss of the individual component based on changes in the moisture, and fat content
r - is the raw lean (or fat) component
c - is the corresponding cooked lean (or fat) component

This formula is based on the assumption that changes in weight of the individual lean and fat components on cooking can be totally attributed to the movement of moisture and fat from the raw matrix, and that no flux of protein nor ash occurred. That is to say:

$$\frac{\%\ Moisture_r + \%\ Fat_r - x}{100g_r - x} \text{ is equivalent to } \frac{\%\ Moisture_c + \%\ Fat_c}{100g_c}$$

**Table 1: The Gross Compositions of the Raw, NHF Approved Beef Cuts.**

| NHF Approved Beef Cut | Mean Weight (g) | Lean (%) | Fat (%) | Gristle (%) | Dissection Loss (%) | Relative Proportions Lean (%) | Relative Proportions Fat (%) |
|---|---|---|---|---|---|---|---|
| Eye fillet steak | 270 | 91 | 5 | 3 | 1 | 95 | 5 |
| Eye fillet roast | 500 | 92 | 4 | 3 | 2 | 96 | 4 |
| Rump steak | 240 | 91 | 4 | 3 | 2 | 96 | 4 |
| Silverside steak | 275 | 95 | 1 | 2 | 1 | 99 | 1 |
| Silverside roast | 955 | 95 | 2 | 2 | 2 | 98 | 2 |
| Skirt steak | 310 | 93 | 3 | 3 | 1 | 97 | 3 |
| Blade steak, boneless | 255 | 94 | 2 | 4 | 1 | 98 | 2 |
| Round steak | 265 | 92 | 4 | 3 | 1 | 96 | 4 |
| Sirloin steak | 240 | 88 | 7 | 4 | 1 | 93 | 7 |
| Topside steak | 280 | 95 | 2 | 2 | 1 | 98 | 2 |
| Topside roast | 1140 | 94 | 3 | 2 | 2 | 97 | 3 |
| Topside strips | 305 | 94 | 2 | 2 | 3 | 98 | 2 |
| Topside cubes | 300 | 95 | 1 | 1 | 3 | 99 | 1 |

**Table 2: The Nutrient Compositions of the Raw, NHF Approved Beef Cuts (per 100g edible portion)**

| Raw NHF Approved Beef Cut | Water (g) | Protein (g) | Fat (g) | Ash (g) | Energy (kJ) | Cholesterol (mg) | Sodium (mg) | Potassium (mg) | Calcium (mg) | Iron (mg) | Magnesium (mg) | Zinc (mg) | Phosphorus (mg) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Eye fillet steak | 72.4 | 20.7 | 7.5 | 1.1 | 631 | 69 | 49 | 360 | 4 | 3.3 | 20 | 3.2 | 205 |
| Eye fillet roast | 72.8 | 20.9 | 6.9 | 1.1 | 612 | 68 | 49 | 360 | 4 | 3.4 | 20 | 3.2 | 205 |
| Rump steak | 70.2 | 22.5 | 6.0 | 1.0 | 606 | 69 | 48 | 365 | 6 | 2.7 | 19 | 3.9 | 205 |
| Silverside roast | 73.8 | 22.0 | 3.3 | 1.0 | 500 | 68 | 48 | 365 | 4 | 2.5 | 20 | 3.3 | 200 |
| Silverside steak | 74.0 | 22.1 | 3.1 | 1.0 | 493 | 67 | 48 | 365 | 4 | 2.5 | 20 | 3.3 | 200 |
| Skirt steak | 73.3 | 22.1 | 4.1 | 1.0 | 528 | 68 | 64 | 335 | 5 | 1.8 | 21 | 5.3 | 200 |
| Blade steak | 72.8 | 21.0 | 5.9 | 1.0 | 579 | 52 | 63 | 350 | 10 | 2.0 | 20 | 4.1 | 190 |
| Round steak | 72.4 | 20.4 | 6.5 | 1.0 | 592 | 59 | 65 | 320 | 3 | 1.4 | 24 | 4.0 | 195 |
| Sirloin steak | 67.6 | 20.4 | 10.9 | 1.0 | 753 | 52 | 59 | 350 | 18 | 1.7 | 20 | 3.2 | 200 |
| Topside steak | 72.7 | 21.3 | 4.6 | 1.0 | 533 | 50 | 53 | 345 | 3 | 1.9 | 27 | 2.9 | 210 |
| Topside roast | 72.6 | 21.3 | 4.7 | 1.0 | 538 | 50 | 53 | 345 | 3 | 1.9 | 26 | 2.9 | 210 |
| Topside strips | 73.0 | 21.4 | 4.2 | 1.0 | 519 | 50 | 53 | 345 | 3 | 1.9 | 27 | 3.0 | 210 |
| Topside cubes | 73.3 | 21.4 | 3.9 | 1.0 | 511 | 49 | 53 | 350 | 3 | 1.9 | 27 | 3.0 | 210 |
| Lean beef mince | 71.6 | 20.3 | 6.9 | 1.0 | 600 | 51 | 63 | 360 | 5 | 2.3 | 20 | 4.3 | 200 |

| Raw NHF Approved Beef Cut | Thiamin (mg) | Riboflavin (mg) | Niacin (mg) | Niacin eq (mg) | Retinol (ug) | B-Carotene eq (ug) | Retinol eq (ug) | Vitamin C (mg) | Fatty Acid Profile Total Sat. (g) | Total Mono. (g) | Total Poly. (g) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Eye fillet steak | 0.13 | 0.23 | 4.1 | 7.6 | 0 | 0 | 0 | 1 | 3.3 | 3.3 | 0.3 |
| Eye fillet roast | 0.13 | 0.23 | 4.2 | 7.7 | 0 | 0 | 0 | 1 | 3.0 | 3.0 | 0.3 |
| Rump steak | 0.10 | 0.25 | 4.7 | 8.5 | 0 | 0 | 1 | 1 | 2.7 | 2.7 | 0.2 |
| Silverside roast | 0.08 | 0.23 | 2.6 | 6.3 | 1 | 0 | 1 | 1 | 1.4 | 1.4 | 0.1 |
| Silverside steak | 0.08 | 0.23 | 2.6 | 6.3 | 1 | 0 | 1 | 1 | 1.3 | 1.3 | 0.1 |
| Skirt steak | 0.05 | 0.24 | 4.1 | 7.8 | 1 | 0 | 1 | 1 | 1.8 | 1.8 | 0.2 |
| Blade steak | 0.07 | 0.16 | 4.1 | 7.6 | 1 | 0 | 1 | 1 | 2.5 | 2.5 | 0.4 |
| Round steak | 0.06 | 0.15 | 3.6 | 7.0 | 3 | 0 | 3 | 1 | 3.0 | 2.8 | 0.3 |
| Sirloin steak | 0.07 | 0.11 | 5.1 | 8.6 | 3 | 0 | 3 | 0 | 4.9 | 4.8 | 0.4 |
| Topside steak | 0.08 | 0.14 | 6.0 | 9.6 | 1 | 0 | 1 | 2 | 1.9 | 2.0 | 0.2 |
| Topside roast | 0.08 | 0.14 | 6.0 | 9.5 | 1 | 0 | 1 | 2 | 2.0 | 2.1 | 0.2 |
| Topside strips | 0.08 | 0.14 | 6.0 | 9.6 | 1 | 0 | 1 | 2 | 1.7 | 1.8 | 0.2 |
| Topside cubes | 0.08 | 0.14 | 6.1 | 9.6 | 1 | 0 | 1 | 2 | 1.6 | 1.7 | 0.2 |
| Lean beef mince | 0.03 | 0.06 | 3.7 | 7.0 | 0 | - | 0 | - | 3.1 | 2.3 | 0.2 |

## Table 3: The Derivation of the Relative Proportion of Cooked Lean Meat and Fat

| NHF Approved Beef Cut | Cooked Reference Cut from The Australian Food Composition Tables 1989 | Cooking Method Applied to Raw Cut | Cooking Loss of Reference Cut by Listed Cooking Method | | Derived Relative Proportion Cooked Lean & Fat | |
|---|---|---|---|---|---|---|
| | | | Loss of Lean % | Loss of Fat % | Lean (%) | Fat (%) |
| Eye fillet steak | Fillet steak | grilled | 29 | 51 | 96 | 4 |
| Eye fillet roast | Silverside roast | roasted | 27 | 44 | 97 | 3 |
| Rump steak | Rump steak | grilled | 23 | 56 | 97 | 3 |
| Silverside steak | Fillet steak | grilled | 29 | 51 | 99 | 1 |
| Silverside roast | Silverside roast | roasted | 27 | 44 | 99 | 1 |
| Skirt steak | Skirt steak | stewed | 35 | -18 | 95 | 5 |
| Blade steak | Blade steak | grilled | 25 | 34 | 99 | 1 |
| Round steak | Skirt steak | stewed | 35 | -18 | 92 | 8 |
| Sirloin steak | Sirloin steak | grilled | 27 | 49 | 95 | 5 |
| Topside steak | Skirt steak | stewed | 35 | -18 | 96 | 4 |
| Topside roast | Silverside roast | roasted | 27 | 44 | 98 | 2 |
| Topside strips | Lamb, stir fry | stir fried | 23 | 11 | 98 | 2 |
| Topside cubes | Skirt steak | stewed | 35 | -18 | 98 | 2 |

**Table 4: The Nutrient Compositions of the Cooked, NHF Approved Beef Cuts (per 100g edible portion)**

| Cooked NHF Approved Beef Cut | Moisture (g) | Protein (g) | Fat (g) | Ash (g) | Energy (kJ) | Cholesterol (mg) | Sodium (mg) | Potassium (mg) | Calcium (mg) | Iron (mg) | Magnesium (mg) | Zinc (mg) | Phosphorus (mg) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Eye fillet steak | 60.8 | 29.5 | 10.2 | 1.3 | 880 | 83 | 59 | 375 | 6 | 4.0 | 22 | 4.3 | 250 |
| Eye fillet roast | 60.9 | 29.6 | 10.0 | 1.3 | 875 | 83 | 59 | 375 | 6 | 4.0 | 22 | 4.4 | 250 |
| Rump steak | 59.9 | 32.1 | 8.5 | 1.1 | 861 | 83 | 54 | 355 | 5 | 3.8 | 18 | 5.0 | 250 |
| Silverside roast | 60.6 | 33.5 | 5.4 | 1.1 | 772 | 82 | 50 | 330 | 5 | 3.8 | 23 | 5.4 | 235 |
| Silverside steak | 60.6 | 33.5 | 5.4 | 1.1 | 770 | 82 | 50 | 330 | 5 | 3.8 | 23 | 5.4 | 235 |
| Skirt steak | 58.0 | 34.4 | 7.8 | 1.0 | 878 | 83 | 64 | 265 | 5 | 2.7 | 20 | 10.0 | 230 |
| Blade steak | 63.8 | 28.4 | 7.6 | 1.1 | 767 | 65 | 73 | 365 | 13 | 2.5 | 23 | 5.8 | 220 |
| Round steak | 60.2 | 28.7 | 10.5 | 1.1 | 878 | 74 | 61 | 345 | 5 | 2.0 | 30 | 5.4 | 230 |
| Sirloin steak | 58.4 | 27.7 | 11.7 | 1.0 | 904 | 68 | 73 | 370 | 25 | 2.8 | 25 | 4.6 | 245 |
| Topside steak | 64.0 | 25.8 | 7.7 | 1.0 | 726 | 67 | 55 | 330 | 4 | 2.3 | 25 | 3.8 | 225 |
| Topside roast | 65.0 | 26.2 | 6.2 | 1.0 | 677 | 66 | 56 | 335 | 4 | 2.4 | 26 | 3.9 | 230 |
| Topside strips | 65.0 | 26.2 | 6.2 | 1.0 | 676 | 66 | 56 | 335 | 4 | 2.4 | 26 | 3.9 | 230 |
| Topside cubes | 64.8 | 26.1 | 6.4 | 1.0 | 684 | 66 | 56 | 335 | 4 | 2.4 | 25 | 3.9 | 230 |
| Lean beef mince | 64.4 | 25.8 | 7.9 | 1.3 | 731 | 68 | 85 | 470 | 6 | 3.0 | 25 | 5.2 | 250 |

| Cooked NHF Approved Beef Cut | Thiamin (mg) | Riboflavin (mg) | Niacin (mg) | Niacin eq (mg) | Retinol (ug) | B-Carotene eq (ug) | Retinol eq (ug) | Vitamin C (mg) | Fatty Acid Profile Total Sat. (g) | Total Mono. (g) | Total Poly. (g) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Eye fillet steak | 0.13 | 0.32 | 5.8 | 10.8 | 0 | 0 | 0 | 0 | 4.6 | 4.3 | 0.3 |
| Eye fillet roast | 0.13 | 0.32 | 5.9 | 10.8 | 0 | 0 | 0 | 0 | 4.5 | 4.3 | 0.3 |
| Rump steak | 0.10 | 0.36 | 6.5 | 11.8 | 1 | 0 | 1 | 0 | 3.8 | 3.6 | 0.3 |
| Silverside roast | 0.90 | 0.37 | 4.1 | 9.7 | 1 | 0 | 1 | 0 | 2.4 | 2.3 | 0.2 |
| Silverside steak | 0.90 | 0.37 | 4.1 | 9.7 | 1 | 0 | 1 | 0 | 2.4 | 2.3 | 0.2 |
| Skirt steak | 0.40 | 0.38 | 6.4 | 12.2 | 1 | 0 | 1 | 0 | 3.6 | 3.4 | 0.2 |
| Blade steak | 0.11 | 0.21 | 4.2 | 8.9 | 0 | 0 | 0 | 0 | 3.3 | 3.3 | 0.3 |
| Round steak | 0.80 | 0.15 | 3.9 | 8.7 | 2 | 0 | 2 | 0 | 4.6 | 4.3 | 0.3 |
| Sirloin steak | 0.10 | 0.14 | 5.9 | 10.5 | 2 | 0 | 2 | 0 | 5.5 | 4.8 | 0.4 |
| Topside steak | 0.11 | 0.16 | 5.8 | 10.1 | 2 | 0 | 2 | 0 | 3.3 | 3.6 | 0.3 |
| Topside roast | 0.11 | 0.16 | 5.9 | 10.3 | 1 | 0 | 1 | 0 | 2.6 | 2.8 | 0.3 |
| Topside strips | 0.11 | 0.16 | 5.9 | 10.3 | 1 | 0 | 1 | 0 | 2.6 | 2.8 | 0.3 |
| Topside cubes | 0.11 | 0.16 | 5.9 | 10.3 | 1 | 0 | 1 | 0 | 2.7 | 2.9 | 0.3 |
| Lean beef mince | 0.50 | 0.05 | 4.5 | 8.8 | 8 | - | 8 | - | 3.5 | 3.4 | 0.3 |

## REFERENCES

Cashel, K., English, R., and Lewis, J. (1989). ***Composition of Foods, Australia***. Volume 1. Australian Government Publishing Service, Canberra.

Greenfield, H., Kuo, Y.L., Hutchison, G.I., and Wills, R.B.H. (1987). Composition of foods. 34. Beef and veal. ***Food Technology in Australia,*** 39,5: 208-215, 227.

Hutchison, G.I, Thomas, D.E., and Truswell, A.S. (1987). Nutrient composition of Australian beef. ***Food Technology in Australia,*** 39,5: 199-201.

Lewis, J., and Holt, R. (1991). **NUTTAB91-92.** ***Nutrient Data Table for Use in Australia.*** Canberra: Australian Government Publishing Service.

# APPENDIX 7

## THE ENERGY AND CHOLESTEROL CONTENT (PER 100 GRAMS) OF THE COMPARABLE BEEF CUTS PRESENTED IN THE 1989 FOOD COMPOSITION TABLES

| Beef Cut | Energy Content (kJ per 100 grams) | Cholesterol Content (mg per 100 grams) |
|---|---|---|
| Fillet Steak (raw) | 737 | 70 |
| Fillet Steak (grilled) | 974 | 85 |
| Rump Steak (raw) | 958 | 73 |
| Rump Steak (grilled) | 1130 | 86 |
| Silverside non-corned (raw) | 780 | 71 |
| Silverside non-corned (baked) | 969 | 85 |
| Skirt Steak (raw) | 514 | 68 |
| Skirt Steak (simmered) | 827 | 83 |
| Blade Steak (raw) | 746 | 55 |
| Blade Steak (grilled) | 863 | 67 |
| Round Steak (raw) | 677 | 59 |
| Round Steak (grilled) | 849 | 73 |
| Sirloin Steak (raw) | 965 | 54 |
| Sirloin Steak (grilled) | 1150 | 73 |
| Topside Roast (raw) | 604 | 51 |
| Topside Roast (baked) | 800 | 68 |
| Regular Beef Mince (raw) | 738 | 63 |
| Regular Beef Mince (simmered drained) | 764 | 69 |

(Cashel, K. et al., 1989)